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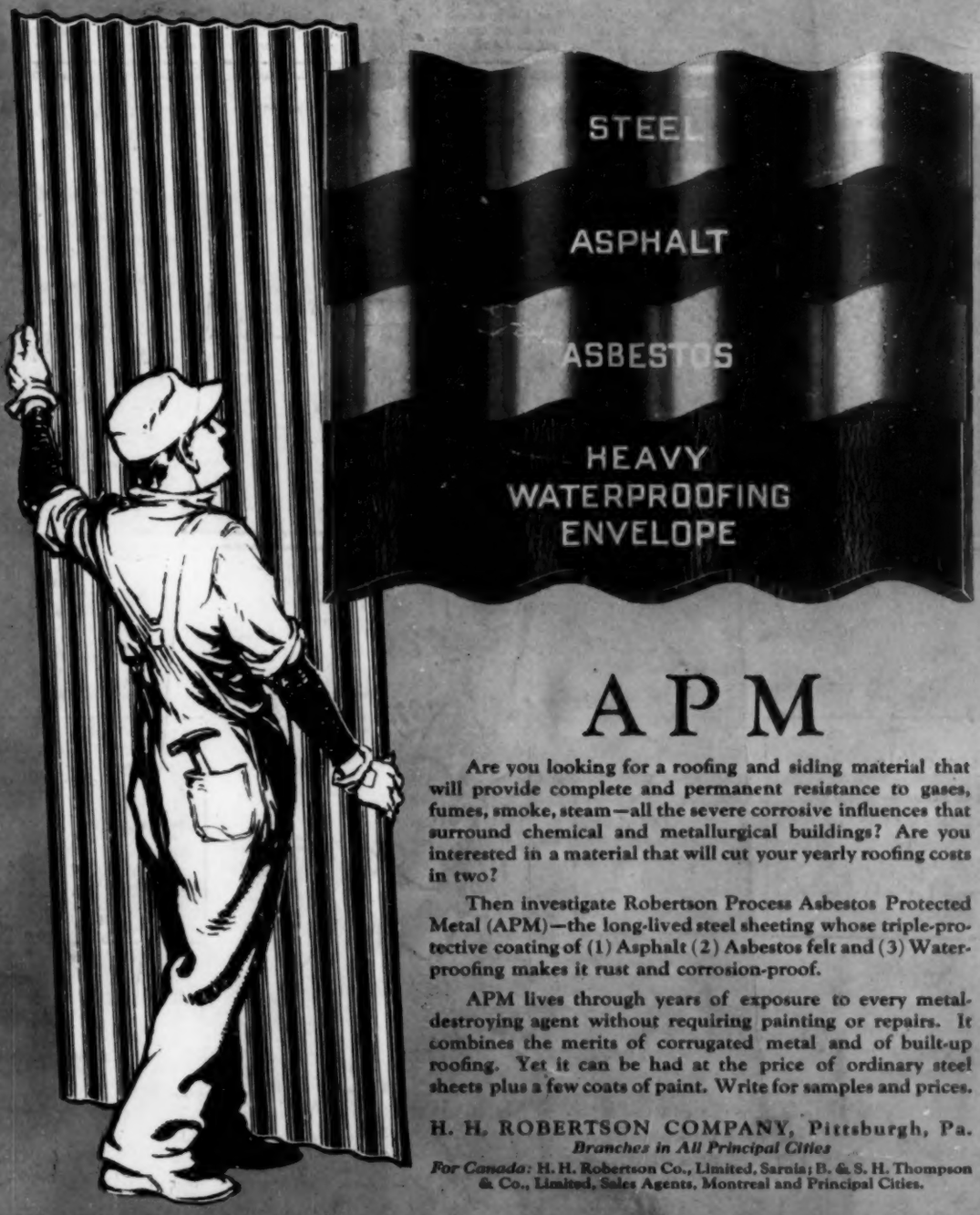

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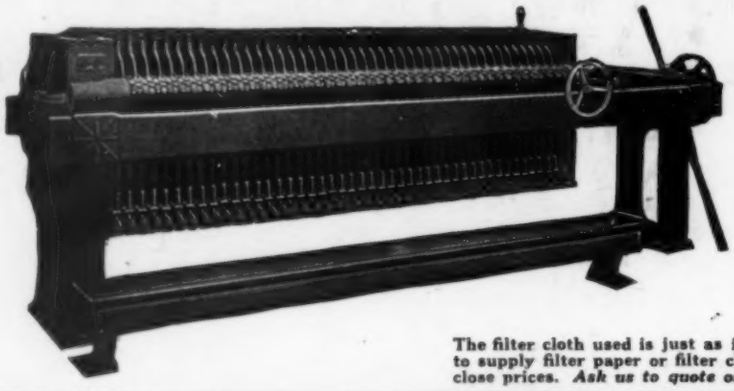

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H. C. PARMELEE, Editor

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Benjamin Franklin And National Thrift

THE date of this issue is the 217th anniversary of the birth of BENJAMIN FRANKLIN. There is probably no American living who will remain so eminent. He was a printer and publisher, which we of today count an abundant calling. He addressed himself for the short period of six years to science, and who can match the signal importance of his discovery? Having completed his work in respect to electricity, he regarded the matter as a closed book and hardly even referred to it again. He signed the Declaration of Independence, and those of us who can boast of any ancestor who was a "signer" are disposed to be rather cocky about it. He organized the U. S. Post Office. He was a philosopher and contributed richly to the thought of the eighteenth century. In his old age he was a great and successful ambassador; proving himself a master of statecraft. And he had a great and glorious time in living.

Throughout his days he preached and practiced the gospel of thrift. He kept the thought alive in his mind that material progress is dependent on savings. We know this just as well as FRANKLIN did, but we don't hold fast to the idea. We let it slip away unremembered. We know that every railroad, every telegraph and telephone line, every business undertaking, is established and organized and brought into being and into function by means of dollars that have not been spent on living. Whatever we earn and do not spend is in the bank, or in life insurance, or in investments. Few of us keep it in stockings. The capital of a nation is the reserve of that nation; the reserve that has not been spent on living. We may not make loans on investments ourselves, but if we do not, then our banks do. Whatever we set aside becomes busy money. The reason why we do not make the loans and investments is because we do not save enough. As soon as we have enough, then we buy bonds and stocks, or real estate, or let out our money on bond and mortgage. If we do not save, but spend whatever we earn on living, we do not participate in the wealth of the nation. We are out of it as contributors. We may make wealth by what we do, but the direct contributors are the owners of the shops where we spend our earnings. As between the improvident man who adds by his thought to human welfare and the publican with whom he spends his substance, the source of value is with the former, but the credit and the rewards go to the latter. FRANKLIN knew this and sensed it; hence his constant preaching to save pennies. We all know it too, but many of us do not sense it well enough to remember it when pay day comes around. So the week following FRANKLIN'S birthday has been selected and established by a large number of organizations as Thrift Week. Thrift is to be preached and sounded and rung out and declared by all the arts of advertising and suggestion and applied psychology.

It's curious, but when we consider the contributions of America to the philosophy of life, the first American philosopher who was not at once a theologian and a dogmatist urged thrift upon everybody. And yet of all the civilized nations of the earth our thrift index is certainly the lowest in proportion to our earnings. It is absurd to declare that, so long as money is in circulation, it adds to wealth. It doesn't. Let's take a concrete example. Suppose you have a farm on stony ground. You employ ten men at $3 a day to pick up the stones from one field and throw them into another. Then you employ the same ten men to pick up stones from the second field and throw them back again into the first. They have been employed, and have had their wages, but nothing has been accomplished by you. That is an example of luxury. But suppose you employ the same men to throw the stones from the first field upon a pile and then to plough and sow the field, the while you sell the stones for road-making. That is an example of thrift, and you have a good farm and some extra capital to operate it, while the community has a good road.

It takes head-work to save. The lower orders of people, the inferior persons, can't sense this. They can't compute consequences. But intelligent people look ahead and adjust expenditures to income. They set aside what they do not use. They are wise, like the thoughtful men who made our country for us.

M. C. Whitaker, Perkin Medalist

ADDED to the roster of those distinguished industrial chemists who have been awarded the Perkin medal is the name of MILTON C. WHITAKER. In his selection the representatives of the Society of Chemical Industry and the affiliated chemical and electrochemical societies have indeed made a happy choice, for measured in the wholesome esteem of his fellow chemists WHITAKER is without a peer. And in his industry his position is equally unique. Many of us have acquired the habit of referring to him with some little pride as the sort of executive that is sorely needed by many of our chemical industries. Our respect for him is not solely prompted by the fact that he is a technical man in charge of a great technical organization, but also because, as a man of vision, he has guided that organization with a full sense of the fundamental value of the science on which it rests. At a time when many short-sighted industrial leaders were abandoning research and scrapping their investigational department, scientific inquiry under Dr. WHITAKER'S direction was being prosecuted with increasing zeal. The result was that great and fundamental accomplishment came from his laboratory and research plant. Development work was

continued even during the worst of the business depression. Several products once regarded only as laboratory curiosities were brought out on a large commercial scale. The marketing of absolute alcohol in tank car quantities is but one of the signal accomplishments destined to have almost revolutionary effect on many industrial processes and materials.

To learn of Dr. WHITAKER'S early life and environment is to account for much that he is today. Even as a student he was able to go out in charge of Western lumber camps. This indicated at an early age his leadership of men and his ability to get things accomplished with the least waste of time and money. His native gift and later development of mechanical skill has stood him in good stead. One of his old professors says of him, "He could always do anything with his hands." His unusual power to grasp details in plant construction and to sense and remedy operating defects give credence to the statement. Insights such as these characterize ARTHUR D. LITTLE'S excellent appreciation of the life and human qualities of the medalist.

But it is primarily as an organizer that Dr. WHITAKER has been honored. He has built up organizations that stand as monuments to his record of constructive achievements. In his address of acceptance, we believe our readers will find an unusual exposition of the basic principles that underlie all industrial organizations. He sounds the keynote for success, not alone for chemical production, but in all lines in which science is applied to industry.

Get Out Of the Red

IN what follows we should like to talk to the men responsible for technical control, to the men in charge of the testing department, to the men who are interested in putting quality into the product.

It is seldom realized that the total volume of production of a manufacturing organization is attained through two main groups of influences. First, there are what might be called positive factors—a great number of circumstances such as labor-saving equipment, proper routing, low turnover of workmen, all together swelling the production. It is upon these favorable factors which the "efficiency expert" and production manager spend the most time. Every success is properly bulletined, and appears in the most favorable light in the daily reports going over the manager's desk, and in turn are passed on to the board of directors. None of the latter are so obtuse as to doubt that men who can increase the production of a certain machine by 10 per cent are valuable employees.

But not all the working conditions are favorable. There are a number—often a surprisingly large number—which may be grouped as negative factors, influences which tend to decrease production. In a plant manufacturing articles of metal many of these factors have to do with the quality of metal entering the plant, and of the tools used in its fabrication. And the activities of the metallurgist and the testing department are to a great extent confined to the removal of these drag anchors. Their work is not spectacular, it does not advertise itself, and unfortunately those men actually doing the work do not see to it that the manager gets news of their successes. Nobody makes much of a fuss about the rejection of a certain shipment of metal, practically certain to produce 10 per cent faulty pieces—nobody perhaps except the purchasing agent who thought he was getting a bargain in raw material. But it requires no argument to prove that the man who can prevent a large percentage of rejections (or dissatisfaction by customers) is as important as he who can get ten completed units where nine only came before.

In short, total production is the difference between positive factors and negative. The metallurgist often is intent on cutting away the latter, and rightly, but unfortunately his successes never are segregated in the reports, and he seldom can point to a certain positive thing as his achievement. What is more natural, then, than that he should be regarded merely as a salary expense to be lopped off at the first demand for economy?

Metallurgists, to come into their own, must therefore get off the debit side and into the credit side of the ledger. Cultivate the auditor, and have him start an account for the testing department, as he has already done for the warehouse. These people usually do business like a department store—they buy and stock all manner of things used about the plant, and sell them upon demand, charging a sufficient margin to cover the cost of handling, purchasing and bookkeeping. At the end of the year, they show a certain small profit on the books. Is this service fundamentally different from that rendered by the testing department? If the purchasing agent were to have a shipment inspected and analyzed by an independent laboratory he certainly would expect to pay for the report, and the expense would be loaded on the selling price when the material left the warehouse. Or, if the grinding department was having troubles with "alligator cracks" and secured the advice of a consultant, they would not balk at the fee.

Just because a plant has a testing department, metallurgist and chemist is no reason why that department or those men should be called upon to do all these jobs for everybody gratis. The surest way to get on the right side of the ledger is to have a departmental account started. Then charge a fair fee for the services rendered, and insist upon a credit whenever large savings result from an independent investigation. You'll be surprised how quickly you get out of the "red ink."

Lime Manufacture A Chemical Industry

"OUR aim has been to place the lime industry on the same footing as any other chemical industry. In the past it has, in this country [England], been treated more like the manufacture of bricks for example; and even in America it is only in recent years it has risen to its proper place as the industry concerned in the manufacture of one of the most important chemical reagents."

The compliment which is so gracefully expressed by our British friend quoted above is well deserved by some of the American producers; but there are others who still lag far behind in their progress toward a better understanding of what chemical lime really is, what standards of composition and performance can be expected of it, and how most economically to produce the optimum quality. The statement really indicates only an important trend in this important industry. It is a trend that might be speeded up by greater chemical activity in lime manufacture without any detriment either to manufacturers or users.

The making of high-grade chemical lime at the lowest cost demands no little chemical engineering skill. He who neglects to recognize this fact will shortly find himself outdistanced by more progressive competitors.

What's Behind The Stock Dividend?

THE EPIDEMIC of stock dividends which broke out so virulently during the closing months of the old year continues to excite public discussion. Opinions continue to differ widely as to their purpose and effect. In view of the leading part played by the Standard Oil group in the distribution of such dividends, particular interest attaches to the vigorous defense of the policy advanced by A. C. BEDFORD in his recent address before the American Petroleum Institute at St. Louis.

Mr. BEDFORD flatly denies that stock dividends result in any tax evasion. Further he makes a strong plea for the essential soundness of the process of building up a surplus from current earnings, plowing it back into the business and capitalizing it through the issuance of new shares to old stockholders. The issuance of the stock dividend, he insists, means merely "changing a dollar into four quarters." It creates no new wealth.

Economists and accountants generally will agree that the simple act of declaring a stock dividend creates no new wealth. They will also agree that the increase of the capital fund is essential to the progress of business and the country generally. Finally, they will admit that the stock dividend does not offer a method of tax evasion in any legal sense. However, having conceded all of these points, an honest, inquiring mind may still hunger for a deeper analysis than Mr. BEDFORD has made. Is there nothing more than this to the stock dividend epidemic? Is there no rational explanation for the conviction so generally prevalent that the stock dividend is significant of some condition which needs correction?

Mr. BEDFORD apparently accepts the orthodox definitions of wealth and income, for he argues that the stock dividend is not income because it creates no "new wealth." One has income when his wealth—his economic strength, in the sense of command over goods and services—has increased. This is the general conception of income which underlies our federal income tax law. With this definition in mind, let us raise a few queries which may serve to clarify the issues.

Suppose you were to invest twenty-five cents in the Standard Oil Company of New Jersey. Suppose the company prospers and builds up a large surplus, your share of which amounts to the value of seventy-five cents, so that your interest in the company is now worth a dollar. Suppose the company declares a stock dividend "changing the dollar into four quarters." Has anything of significance happened? Has your economic strength increased? Have you received any income?

Clearly the stock dividend simply recognizes an existing situation. It recognizes that the quarter has expanded into a dollar and makes the convenient "change." But the significant thing is that you are ahead to the extent of seventy-five cents in value—not merely because of the stock dividend—but as the result of the whole process. At the beginning you had a quarter invested in productive enterprise. Now you have an investment worth, by assumption, a dollar.

The real nub of the matter from the tax point of view is this: The process described in the above example is about the only way you can make seventy-five cents and reinvest it in productive enterprise without subjecting the three new quarters to the heavy surtaxes of the federal income tax. The corporation pays the normal tax (slightly higher, it is true, than the individual normal rate) when it adds the new quarters to surplus, but you are asked to account for them only *if* and *when* the corporation distributes them to you as a cash dividend or *if* and *when* you sell your stock at the enhanced value due to the surplus which has been built up. Thus, this "if and when" is of considerable importance.

If you had invested your original quarter in an equally prosperous individual enterprise or partnership you would have been asked not only to pay the normal tax as the new quarters were earned and reinvested, but would also have been compelled to pay the surtaxes on them *when earned* rather than "if and when" distributed or "if and when" the stock was sold at an advance.

Clearly the corporate form of business organization has an advantage under the tax law because of this situation and the stock dividends are advertising this advantage in a most striking manner. It is this advantage which is really the shining mark at which the "agitators" are aiming. Is it not an advantage which must in some manner be equalized if the "sturdy qualities" of individual initiative and resourcefulness, which Mr. BEDFORD so properly praises, are to be given full play?

How to accomplish this is, indeed, perhaps the most puzzling tax problem which the federal government is facing. It cannot be solved by refusing to recognize its existence or by approaching it from the point of view of one industry, one form of business organization, or one economic class. The differential in favor of the corporation may conceivably be removed by increasing the burden on the corporations or by decreasing the burden on the other forms of business enterprise. The "agitators" suggest a new tax on the undistributed surplus of corporations as closely equivalent as possible to the present surtax burden on reinvested earnings of other forms of business enterprise—a suggestion which Mr. BEDFORD labels "a proposal of sabotage by legislation." The fear of such a tax is probably a contributing cause, although not the sole or perhaps not the most important cause of the stock dividend epidemic. The alternative plan for eliminating the corporations' differential would be to reduce the present burden upon reinvested profits of partnerships and individuals. But he who proposes this must be prepared to convince the public that a dollar of wages should be more heavily taxed than the dollar of reinvested profit. This is the dilemma!

Co-operating With The Customs Authorities

MORE than usual significance attaches to the important series of conferences now under way for the purpose of considering the proposed rules and regulations which will govern the Treasury Department in administering the new tariff law. For the first time in history manufacturer as well as importer is being given a chance to participate in the discussion. He is expected to contribute valuable basic information on prices and commodities, particularly as regards coal-tar products. The tariff act of 1922 contains many snarls of construction and definition which are yet to be untangled and the net result of these conferences will often determine whether or not certain of the protective provisions will actually become effective. Later, it is our intention to give more detailed consideration to some of these administrative difficulties, but in the meantime we believe that the customs authorities should receive the fullest co-operation from the chemical industry.

Milton C. Whitaker, Perkin Medalist, 1923

Sixteenth Award for Meritorious Accomplishments in Applied Chemistry Goes to Industrial Leader Characterized as "Investigator, Organizer and Doer"—Addresses of Appreciation by Associates—Presentation by Charles F. Chandler

IT IS particularly significant that this year the Perkin medal should have been awarded to an outstanding industrial leader who has actively sponsored fundamental research and through it has built up a great and lasting chemical industry. These were the "meritorious accomplishments in applied chemistry" that prompted the joint committee of the chemical societies to award this coveted medal to Milton C. Whitaker, president of the U. S. Industrial Chemical Co. and vice-president and director of the U. S. Industrial Alcohol Co. The presentation took place under auspicious circumstances at the meeting of the American Section of the Society of Chemical Industry, held in Rumford Hall, New York City, Jan. 12, 1923.

In his introductory remarks, Prof. Ralph H. McKee, chairman of the section, referred briefly to the founding of the medal in 1906 and to the list of illustrious chemists, beginning with Sir William H. Perkin himself, who have since received the award. At this point a little leaven was added to the otherwise heavy program by the reading of a number of congratulatory telegrams, not the least significant of which came from the Anti-Saloon League of America and the Kelly-Pool Gang of the Chemists' Club.

The first of the speakers was Arthur A. Backhaus, introduced by Chairman McKee as "one of that large group of young men who have worked under and with Dr. Whitaker and have helped him to bring to successful accomplishment several significant commercial enterprises." Mr. Backhaus, with an apology that "a close-up on so large a subject is likely to be very much out of focus" proceeded to share with the audience his "Impressions of the Medalist." His views in part were as follows:

Some Impressionistic Views of Whitaker

BY ARTHUR A. BACKHAUS

During the summer of 1914 Dr. Whitaker, then head of the chemical engineering department at Columbia University, was seeking an assistant. Professor Chambers, with whom I had done my undergraduate work recommended me for the job, which in turn was offered me and I accepted it. The entire negotiation consisted of but two letters, one in which the position was offered, the other in which it was accepted, although neither of us knew the other. I arrived in New York on the morning of September 16, and in the afternoon I reported to Havemeyer Hall, Columbia University, wondering what my new boss was going to look like. Dr. Whitaker was in his office, seated at his desk, completely filling a roomy chair. He had his coat off, sleeves rolled up, hair ruffled, hard at work as one usually finds him. I was impressed, not only by the size of the man but also by his speed, "his velocity coefficient," for before I knew it I had been hustled into the laboratory and put to work. From that day until now I have been honored in calling Dr. Whitaker my boss.

SOME PERSONAL CHARACTERISTICS

Dr. Whitaker has an unusually keen insight into chemical processes and chemical plants. He can size up a plant operation, see the weak spots and suggest remedies or improvements. He invariably turns the spot light on jokers in proposed new processes. His mind not only grasps broad features and general principles, but also takes in minute details.

Dr. Whitaker has said on several occasions, that the successful plant or works superintendent must have the faculty of instinctively "happening on the spot" at the psychological moment.

I have often been impressed with the fact that Dr. Whitaker can make a little chemistry go farther than any man I know. This applies not only to chemistry but to other information. His ability to apply knowledge or practice from an unrelated field to a problem at hand comes up again and again.

It is probably not necessary to dwell upon the ability of Dr. Whitaker to express himself in clear and forcible English. His clearness in expression is due to his extensive vocabulary and his apt choice of similes and metaphors. Many here have probably heard him speak of research chemists as "prima-donnas who must be handled with kid gloves." Unfortunately his most picturesque expressions would not appear well in print.

Dr. Whitaker differs from many other executives in that he thinks his problems out clearly and completely. He not only fixes a definite goal, but also works out, in his own mind, at least one good way of reaching it. In all his dealings with his men he plays the game with all his cards on the table.

Conferring the Medal

Following the delivery by Arthur D. Little of his inspiring appreciation of the medalist, Dr. Charles F. Chandler, senior past president of the Society of Chemical Industry in America, was called upon to make the actual presentation of the medal. The venerable dean of American chemistry read portions of his prepared address which reviewed the life of Dr. Whitaker and listed references to all of his patents and published articles. "It gives me the greatest pleasure," he said, "as the representative of the Society of Chemical Industry and the affiliated chemical and electrochemical societies of America, to place in your hands this beautiful Perkin medal, as a token of the appreciation and affection of your fellow chemists."

In expressing his deep appreciation of the honor thus conferred upon him, Dr. Whitaker said:

> It has been my good fortune to be an organization man rather than an individual worker. Achievements which have resulted in the award of the Perkin medal to me are necessarily therefore achievements of the men with whom I have worked. It would be a pleasure to catalog the names and individual accomplishments of these men, but the list would be so long and involved that it is probably better at this time to generalize. Accordingly the medal is accepted by me, in a representative capacity, as a distinguished honor conferred by the American chemical profession on these men with whom I have been associated in the 30 years devoted to study and practice in the field of applied chemistry.

Dr. Whitaker's address of acceptance, a remarkable exposition of the principles of organization, will be found on pp. 104 to 109.

Chem. & Met., Jan. 17, 1923.

Whitaker and His Work

By Arthur D. Little

MEN are sometimes distinguished for what they do and sometimes for what they are. More rarely are we permitted to honor them for both. Milton C. Whitaker is a chemist who has earned distinction by his works, but he is first, last and all the time a man.

The realm of Chemistry is not a single and isolated state, nor are its workers unionized. It is, instead, a Commonwealth of Federated Nations, each rich in resources of its own which require special aptitudes for their development.

So it happens that Chemistry can only realize the potentialities of her estate through the co-ordinated efforts of workers of many types and diversified endowment. Some must be patient and persistent garnerers of facts and gleaners of detail; others, highly skilled manipulators to divide that which we have called the indivisible. Some must be students and thinkers, whose thinking leads to generalizations. There must be teachers and expounders, to spread the truth, and doubters and disputants, lest error pass for truth. Finally, that mankind may derive material benefits from these accumulations of knowledge, there must come the organizer and doer, whose bottles are tank steamers, whose test tubes are digesters, and his beakers 50,000-gallon tanks. As student, teacher, editor, Milton C. Whitaker has won high place in our esteem, but tonight it is primarily for his position and achievement as the organizer and the doer that we are met to honor him.

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MILTON C. WHITAKER

Those of us whose professional activities center in the study, the class room or the laboratory are commonly inclined to award a disproportionate meed of merit to that one whose discovery of fact, material or reaction supplies the basis for a great industrial development. They seldom recognize or appreciate the obstacles and difficulties along the steep and rocky road which leads from the laboratory to the plant. They do not see the caulkers on the first Burton still closing the leaking seams between hot boiler plates in an atmosphere of gasoline. They do not know how it feels to work sixty-four hours at a stretch to push along repairs or how Saturday looks on Friday with no money in the bank to meet the pay roll. It is a wise invention that knows its own father. Countless examples can be adduced to show that the organizer, the adapter, the engineer plays a part in the development of industry that is often vastly more constructive than that of the discoverer. We commonly and properly attribute the telephone to Bell, but the instrument as we know and use it is the child of many minds and the godchild of the organizer. Barconnot, in 1918, effected in a laboratory operation the conversion of cellulose to sugars and through them to alcohol. It required thereafter nearly a century of effort to transform that relatively simple laboratory procedure into a commercially operative process. The vast and intricate coal-tar industries, which have so greatly stimulated chemical science, owe their many-sided development as certainly to the organizer and administrator as to the laboratory worker, even though that worker be Perkin himself. It is, therefore, peculiarly fitting that the medal, which commemorates Perkin's great contribution to our science and to industry, should this year be bestowed on one who has shown superlative ability in the application of chemistry to industry on the grand scale; who has the faculty of sensing fundamental principles and necessities in their broad commercial and economic relationships and of building on them great producing agencies.

Milton C. Whitaker was born in Frazeysburg, Ohio, December 16, 1870. Doubtless there were boys in Frazeysburg who tried to lick him, but history records none who did. Later, his family moved to Colorado, and during the four years beginning with 1890 young Whitaker worked in the various lumber mills of Stubbs and Jakway, cherishing always the ambition for a college education and a degree in chemistry. The youth showed the quality of the man, and concerning his work the testimony of his employer may be thus summarized. Ability as a mechanic was evident from the first and with it a natural and unusual power to grasp details and detect and remedy defects in plant and operation. He soon became master-mechanic and when a little later, owing to the exhaustion of the local supply of timber, it became necessary to dismantle the mill, transport the equipment and re-erect and house it on a new site, the task was assigned to Whitaker. So well did the youth repay the confidence that the new mill proved the most successful that the company had operated. In 1896 the company decided to build another mill and for this Whitaker, though then at college, prepared the working plans and during his summer vacation supervised construction. It was a good mill, of which its owners said years afterward, "It has not lost a single day because of faulty construction."

So Whitaker earned and saved and studied until in 1897 he was graduated from the Universty of Colorado with the coveted B.S. degree. Degrees have this in common with olives in a bottle and the kisses of a girl:

The first one is hard to get, but the others come more easily. An M.S. from Colorado followed in 1900 and an LL.D. in 1913, and to these the University of Pittsburgh added Doctor of Chemical Engineering in 1915.

Following his graduation Whitaker became instructor in chemistry at Colorado and in 1898 tutor in chemistry at Columbia. Here he came under the benign and stimulating influence of that honored and beloved dean of applied chemistry in America, Dr. Charles F. Chandler, whom he was privileged to serve as private assistant for nearly four years. That in itself was a liberal education.

His Impress of the Mantle Industry

Whitaker's intimate contact with chemical industry and his constructive influence thereon began in 1902, when he went to the Welsbach Co. as chemist, on the recommendation of Dr. Chandler, who had for years been its consultant. From Whitaker's associates in this new connection one learns that his impress on the organization was almost immediate and ultimately profound. He was at first engaged upon work of a purely chemical character in the laboratory under the direction of Dr. H. S. Miner, but through the laboratory he was gradually brought into general touch with the operations of the plant. Whitaker had been with the company only five or six months when Dr. Miner came down with typhoid fever, and the responsibility for production fell upon the shoulders of his assistant. As we should now expect, Whitaker handled affairs in the plant in a masterly way, going at once to fundamentals, and as troubles arose finding the means and methods for the prevention of their recurrence. Collodion was the bugbear of the industry. Its viscosity with the same solvent and concentration varied over wide and confusing range. As with most colloids at that time, little was known concerning methods of controlling this disturbing factor. Whitaker promptly secured a man experienced in the manufacture, installed a small plant, and worked out the problem of control with large resultant savings and the elimination of many difficulties elsewhere in the factory.

In 1903 he went to Shelby, North Carolina, to inspect the company's monazite mines and there became terrifically ill with a digestive trouble, from which he nearly died. It is reported, though difficult of credence, that "he returned a shadow." Happily, the substance is now restored to us.

With renewed health came his appointment as general manager of the company, and Whitaker initiated a general campaign for the improvement of the hidebound methods of the mantle industry. He worked out a new flow-sheet and rearranged the factory. He enunciated the principle that "a man is as good as his boss," and with this sense of responsibility for their performance he picked leaders with a wise discretion and developed them into departmental heads. His ambition was to evolve a self-contained plant and an organization he could leave. He fixed responsibilities and demanded results, organized weekly conferences, established systems of reports that stimulated healthy rivalries, wrote historical and educational bulletins for the sales department, developed a research laboratory and a system of control throughout the plant, built a club house for girl employees, installed a hospital, invented testing machines. He put in a print shop to obviate delays, a lamp shop to broaden sales, a development shop for the incubation of new mechanical ideas. By standardizing the process of collodion dipping he saved twenty per cent of the collodion used. He substituted the electric drive for rope transmission, developed machines to replace hand labor, invented the present system of packing the fragile mantles, improved the equipment and methods of the bleaching room. In short, he was responsible for betterments in practically every stage of the manufacture in the company's plants at Gloucester, New Jersey, Chicago, and Columbus, Ohio, and he left his impress on the industry from the time the order was received until the goods went out on the platform. It is an achievement to handle material efficiently. Whitaker did far more. He developed *esprit de corps* in men and women, created an organization from human beings, and secured and held their warm affection. Small wonder is it that during his connection with the Welsbach Co. costs of production went down steadily and its business more than doubled.

The Return to Columbia

It was with such a background of achievement and experience that Whitaker returned to Columbia in 1910 as professor of chemical engineering. Of his work and influence while there we cannot do better than record the impressions of a student whom he inspired, of a close associate who worked with him in understanding sympathy, and of Dr. Nicholas Murray Butler, his administrative chief.

The student says:

> "It was heretical to cut one of Dr. Whitaker's lectures, and there were never heretics. A class convening for a quiz on multiple-effect evaporation would find, after the bell had rung, that the subject of discussion was the longshoremen's strike just declared that day in New York City. The quiz on evaporation would be given at the following session. In the meantime, wages, living conditions, labor policies and legislation were moved down stage for closer inspection. A chance remark by someone in the class would cause the interruption of the order for the day while some principle of professional ethics, industrial justice or downright decency was explained in a manner that left an indelible impression on the minds of young men. The verbiage of technical texts was never heard in Dr. Whitaker's classes. Even in the routine of teaching fundamentals, things sounded different, more tangible, more homely. And when those fundamentals were brought forth for application to practical problems the pedagogic atmosphere was dispersed completely. Dr. Whitaker's students have perhaps forgotten where they first learned how to select the right type of filter press, but they will always remember who taught them to think like engineers and to behave like men."

The estimate of the associate is this:

> "Nothing but a long talk could possibly cover the subject of Whitaker and his work. I suppose his outstanding characteristic might be called moral and professional courage, with a very high order of sales ability. He loved a problem, he loved to dig out its solution even more, but most of all he loved to put his solution across, to sell it against opposition. At Columbia he made Chemical Engineering. Without him it would never by any feature of identity have been distinguishable from Industrial Chemistry. This is history that went beyond Columbia."

Dr. Butler writes:

> "I rejoice at the good news that Dr. Whitaker is to receive the Perkin medal. He certainly has earned it. He showed while with us marked initiative, administrative capacity and single-minded devotion to science. He realized to the full the close interrelations between what is sometimes called pure science and what is sometimes called applied science and he labored effectively to promote and to develop these relations. So vigorous was his work and so large his influence that a Department of Chemical Engineering was in fact, even earlier

than in form, set off from the Department of Chemistry and put under his direction. We look upon him as one of our own and follow his career with pride and satisfaction."

Combining Chemistry and Finance

Dr. Whitaker had always maintained that the effective teaching of chemical engineering required of the teacher close and continuing contacts with industry. In developing such contacts for himself, he soon established relations with those who stand within the circle of opportunity. His executive ability, soundness of judgment and technical attainments were quickly recognized. He gained the confidence of capital and effected that difficult synthesis which involves the combination of chemistry and finance. As a result, he was called in 1916 to become manager and in 1917 president of the Curtis Bay Chemical Co. and, following reorganizations, president of the U. S. Industrial Chemical Co. and vice-president and director of the U. S. Industrial Alcohol Co. In this latter capacity his position is, in one respect, undoubtedly anomalous. Most manufacturers strive to pass on to their customers the best they can produce. Whitaker turns out a product of surpassing purity, for which the demand is well-nigh universal, and he then deliberately, if not indeed maliciously, adds to it objectionable and insalubrious compounds which remove it from our sphere of non-professional interest.

The technical operations for which Whitaker is ultimately responsible in these two great companies are conducted on a scale of amazing magnitude. They afford convincing evidence of the fundamental importance of alcohol as an industrial raw material and justify the demand of our profession for less burdensome and more intelligent regulation of its industrial use.

The basic activity of these plants is, of course, the manufacture of alcohol from molasses, which in the sugar-producing countries was formerly thrown away in vast amounts. Obviously, however, when alcohol is made on the grand scale fermentation byproducts, though of small percentage value, assume a large significance. Here aldehydes, as well as alcohol, are utilized in vinegar making, fusel oil is split into its component alcohols, the carbonic acid, carefully purified, is compressed in cylinders, sulphate of ammonia and potash are recovered from the distillery slop by evaporation in multiple effect and furnacing.

The alcohol itself is marketed in many forms, each involving special operations. It may go out as tax-paid alcohol, 95 per cent or absolute, or as spirit denatured to meet the requirements of special industries or uses. Much is converted to the familiar solid alcohol and such amounts to tincture of iodine as to require a separate plant for the purification of the element by steam distillation. Many thousands of gallons of anhydrous alcohol are daily mixed with gasoline to produce the motor fuel Alcogas. To those who, like ourselves, have regarded absolute alcohol as a laboratory luxury and who are familiar with the refinements required for its preparation, its production on this scale and at a cost permitting such use stands forth as a conspicuous technical achievement.

The range of Whitaker's professional work is further demonstrated by the varied subject matter of the twenty-two patents granted him as sole or joint inventor. Of these fourteen are in the former class. Among the inventions covered are containers for fragile gas mantles and those for gases and volatile liquids; processes of gas manufacture, distillation, pulping resinous woods, recovering catalysts, and making ethylene; apparatus of varied types and motor fuels. With it all he has found time to publish important papers to the number of twenty-five, dealing with such diversity of topics as the rare earths and their place in industry, water gas and oil gas, the war supply of nitrogen, the cracking of hydrocarbons, the carbonization of coal, and many others.

Professional Appointments and Offices

As members of the American Chemical Society, we gratefully acknowledge our own signal indebtedness to Whitaker for his upbuilding of the *Journal of Industrial and Engineering Chemistry* and for the stimulus of his editorials during the six years ending with 1916. If you would know Whitaker himself and his professional and business attitude, go back to his famous editorial of September, 1912, on "Fussy Administration." If you are an executive, or if you hope to be one, it will give you something to think about.

To the profession generally Whitaker has given generously of his time and effort. In 1911 he served as chairman of the New York Section of the Society of Chemical Industry and in 1914 as president of the American Institute of Chemical Engineers. He was for several years a member of the latter's committee on chemical engineering education and in December, 1910, presented clean-cut, constructive suggestions in a paper on "The Training of Chemical Engineers." From 1915 to 1917 he was president of the Chemists' Club, and that honorable office is no sinecure. While carrying his great responsibilities for the production of war materials at the plant of the U. S. Industrial Chemical Co. at Curtis Bay, he served for two years as advisor to the War Industries Board.

Such, in brief outline and under dim illumination, is the career of the man whom we are proud to honor tonight. We award the Perkin Medal to him because he has shown himself to be a great constructive force in the field of applied chemistry, but it is his intensely human quality for which, after all, we value him most dearly. His corpuscular count is high. He knows men and handles them with consummate skill. He can call a spade a spade and if necessary, he can call it something a whole lot worse.

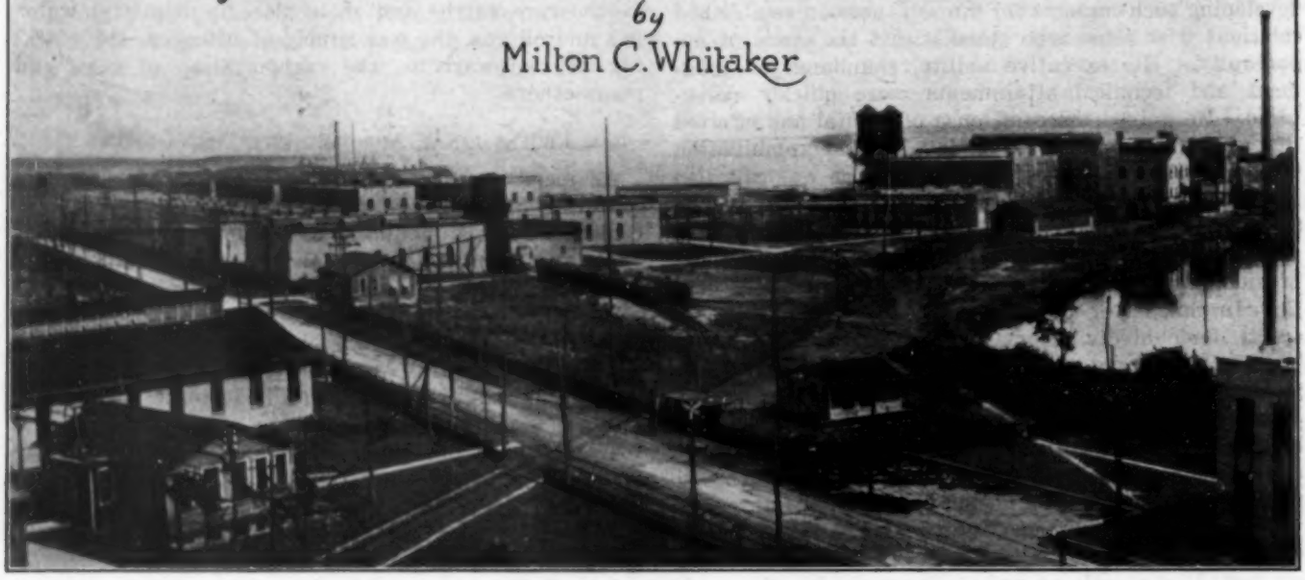
BIRDSEYE VIEW OF RESEARCH PLANT

ORGANIZATION

The Keynote of Successful Chemical Production

by

Milton C. Whitaker



Address of Acceptance on Being Awarded the Perkin Medal by the American Section of the Society of Chemical Industry and Affiliated Chemical and Electrochemical Societies

ORGANIZATION for this or that purpose is a venerated topic for speech makers—especially efficiency experts and others with more or less amateur standing. Organization for chemical development and production has been spared much of this limelight, probably because of the new elements introduced and the greater difficulty in understanding the problem or even the language of chemical industry.

Nevertheless the fact must be recognized that no program of chemical production can be carried through without an adequate organization, any more than mechanical production can be accomplished without operators, or railroads run without men. While research chemists and physicists are laying the foundation for products, processes and plants, it is incumbent upon somebody to develop, study and perfect, concurrently, a suitable organization to carry their research results through the various stages of development and finally to profitable production. Furthermore, organized effort is obviously more rapid, efficient and thorough than single handed work, and this applies to every step from research to sales.

Accordingly, it seems appropriate, in spite of the overworked character of the subject of organization, to outline some of the methods which my associates and I apply to chemical development in order to arrive at the results which the committee of the Society of Chemical Industry has accepted as collectively justifying the great honor of the Perkin medal.

Eight Elements of Organization

Arthur Little once said "There is great danger in an organization chart—someone might mistake it for *an organization*." After this apt, if somewhat blunt, awakening, we would not venture even to submit an organization chart. For the purposes of developing and coordinating the work of organization, the problems requiring individual treatment and timing may be arranged under the following general heads:

1. Objective.
1. Direction and Policy.
3. Research and Engineering.
4. Construction.
5. Operation.
6. Office and Accounting.
7. Sales and Promotion.
8. General Seasoning.

Time will not permit a detailed analysis of the methods of development for each of these organization headings, but the system which we have followed may be illustrated by selected examples.

The objective of an organization requires the most careful analysis. This applies to all organizations, whether old or new. What is it supposed to do and for where is it headed? Obviously the scope and extent of an organization should be adjusted to the facts developed by such an analysis. Overorganization seems to be the most general fault. We saw many cases during the war where there was so much organization that there was no one left to do the work. Frequently we still find organizations "all dressed up and no place to go."

The direction and policy of an organization for chemical production is obviously, on account of its basic position, the most important element of the whole program. An organization without proper and carefully defined policy is like a ship without a rudder. It may gyrate around without going anywhere in particular,

or it may, in close quarters, do a great deal of damage, both to itself and to its neighbors. Furthermore, a policy should be carefully worked out in the beginning and must "stay put." Missteps in the formulation or execution of policy may be of little consequence at the time, but may at some future date loom up like a rock in the channel. In any project of development, therefore, direction and policy deserve and must receive, far in advance, the most profound and intelligent consideration.

Organizing Research

Research and engineering are the logical preliminaries to the development of any new program of chemical production, and we believe are equally necessary to improvement in the efficiency of established operations. Volumes have been written on the subject of organization for research. We claim no originality for the systems which we have adopted, but take this occasion to record some typical schemes followed in our work, in the hope that they may serve as guides to others in what to do or what not to do according to their desires or tastes.

The overhead set-up for research must be analyzed as a preliminary to any plan to develop a research organization. The objective, interest and resources available to the directors and executives are of primary importance in any research program. Their ability to understand the scope of our activities, their confidence in our abilities, their determination to see the thing through, and their capacity to stand disappointments, are qualities which must be measured and will form the foundation on which the program may be built. In short, ambitious researchers must exercise care in the selection of their bosses.

Many research projects are doomed to failure before they start, because of the lack of interest or understanding on the part of the overhead. If research is to be a part of an organization at all, it is entitled to the full benefits of co-operative support of every man in that organization from overhead to office boy. Research men are liable to be sensitive and sometimes temperamental. They respond to encouragement and wholehearted support, while on the other hand, a single knocker may wreck the works.

Sympathetic Direction and Support

The greater portion of our organized research effort has been with the Welsbach Co., Columbia University, the U. S. Industrial Alcohol Co. and the U. S. Industrial Chemical Co. The confidence and undivided support which we have received from the directors and officers of these organizations, and the mistakes they have stood for and paid for, form the basis on which we have been able to build recent organizations.

We always see to it that officers and directors understand what we are trying to do and how we are trying to do it. We discuss our projects and policies and program with them. We do not even deny them the privilege of sharing our disappointments and understanding our failures. We have received in return encouragement, confidence, support.

A president of a corporation or a chairman of a board who reads and understands the research reports, knows and follows the progress of the work of every chemist and engineer in the organization, who champions the fellow who is down and encourages the fellow who is up, and who interprets these results and conditions to his directors, may be a rarity in some programs for the development of chemical production, but in our cases he has been the inspiration. We attribute these conditions to the care we have exercised in the selection and training of our bosses. They doubtless will ascribe it to other reasons.

Our research organizations consist of personnel, equipment, problems. Diversifications of all three of these elements, within the scope of the project, is both necessary and desirable.

Picking Men for Team Work

We have no formula for the selection of the men. We do not believe any one can pick a winner every time from a group of available chemists. Our best guess, based on training, experience and temperament as disclosed by the candidate, is given a trial in the organization and the candidate is given reasonable time to adjust or eliminate himself by a process of natural selection. Many chemists who think they are research men are not qualified either by training, ability or temperament to handle research problems. Yet these same men may be or may develop into excellent plant men. It likewise follows that many chemists who think they are qualified by nature to handle plant problems are essentially research men. Some men are not fitted for either research, plant or sales and would probably do better in insurance or music. A man who is essentially a plant man is liable to be a nuisance in a research laboratory, and on the other hand, a man with research inclinations is a hazard to any production process.

Diversification of training and experience among the members of a research organization is of the utmost value when the organization works as a group. While each investigator may have his particular problem, team work is a necessary element in order to achieve the greatest results.

The man who is inclined or prefers to play a lone hand, who is selfish or secretive, is out of place in any organization. Individual effort is limited to the capacity of a single person, whereas the advantages of an organization should be capitalized by producing results which represent the combined effort and experience and knowledge of a number of men participating. Thus it is that many successful developments come from the laboratory for which it is difficult to award the credit to any individual.

Equipment for industrial research is selected according to the number and scope of our problems, and the amount available is made or acquired in accordance with our needs and the progress of our work. A laboratory for the development of new processes and products should contain all necessary physical and chemical apparatus for the investigation of each fundamental principle involved in the projects under study. Every theory and fact contained in the literature and bearing directly on the problem or related problems is made available to the investigator before work is actually undertaken. We regard this as much a part of our research equipment as the apparatus and desks. Most of these chemical and physical facts and theories have to be checked and confirmed, and the laboratory equipment should be ample to meet these requirements.

Organizing the Expfrimental Unit

As the results of the laboratory work are completed, checked, plotted and discussed, plans are considered for an elaboration of these principles into a small labora-

tory apparatus. Confirmation of theories and reasoning at the laboratory desk and further consideration and discussion of results bring us to the point where co-operation is required between the chemists and the engineers.

We believe that the place to start and finish a real chemical engineering problem is in the research laboratory. For this reason our engineers work with and rank with our research chemists. Personal contact and discussion during the laboratory development and close co-operation in the planning of a semi-commercial unit have avoided many misunderstandings and failures.

Our experimental units have for their purpose much more than the checking of the laboratory results obtained by the research chemist. These units are scaled to a size that will permit of a continuous operation over a considerable period in order definitely to establish engineering data for use in the design of commercial units, and to determine capacity, quality of product and materials of construction. It must also produce a sufficient quantity of the product to enable it to be sold and finally to determine if it meets the supreme commercial test, that is, to *stay sold.*

We operate these experimental units from six months to two years, depending upon conditions, changes required, market tests, etc. During this period, the operation is under the close observation of the research chemists who established the basic data for the process, the engineers who co-operated and designed, and if possible, the mechanics who built the apparatus. Even the plant organization which may ultimately be expected to erect and operate the commercial units, and the sales department which has to sell the product and make it stay sold, are kept in contact with the work.

FIG. 1—CHEMICAL LABORATORY OF RESEARCH PLANT

Incidental to this experimental operation, all questions of quality, specifications, market requirements, containers and natural sales units are determined. The purchasing office becomes familiar with the problems involved in locating, specifying and buying raw materials, the apparent hopelessness of the problem of costs and accounting in the operation becomes clarified for the auditors. And finally the clerks, stenographers and office boys add the new names to their vocabulary and discuss the prospects of the new process with assurance.

Innumerable other elements such as I. C. C. regulations, insurance risk, workman hazards, keeping qualities, etc., are determined so that when commercial units are finally undertaken, all of the elements from design to sale of products are settled and behind us.

Concentration on research problems, based on the needs and requirements of the organization and its policy for development, requires courage and persistence, but it must be regarded as necessary in industrial work. An industrial research laboratory has a different objective from that of the academic institution. We endeavor to achieve constructive results within a limited field, and in a reasonable time, which aim at the building of a plant and the production of a product at a profit. The academic investigator, on the other hand, may choose his problem from the unlimited field and for the purpose of making a contribution to science or of qualifying for a degree. The objective of the industrial investigator is a process and a plant to which he can point with the pride of achievement, whereas the objective of the academic investigator is a contribution to science and publications to which he can with equal fairness point with the pride of authorship. The former measures his success by the amount of factory noise and smoke his work creates, while the latter may modestly acknowledge the cheers of his peers, or may measure his success by the amount of printer's ink he has caused to be consumed.

The Beginnings at Baltimore

Such a research organization as outlined was established in the fall of 1916 in the industrial outskirts of Baltimore. We selected as a building site a large potato patch and surrounded it with a high fence enclosing several acres. Here we developed what might be called a "research plant." We are inflicted with neither neighbors nor architects. The lighting, heating, ventilation and drainage were planned by and for chemists with the result that we have an abundance of each. Architecturally, as may be observed from Fig. 1, the chemical laboratory is below par, but it is what it was built for.

By the beginning of the year this plant was in full operation, manned by chemists specially qualified by analytical, organic, physical or biochemical training, and brought together from Maine to California with a liberal allowance for intermediate points. The chemists were reinforced with engineers, assistants, mechanics and bottle washers. The specific problem placed before this organization was the development of uses of alcohol and the utilization of the byproducts of the alcohol industry.

The work of the laboratory was soon interrupted by war problems and the entire time of the organization was devoted for over a year to the development and improvement of processes for the production of acetic acid, acetone, methyl acetate, ethylene and solvents for airplane dopes. The acetone process, which at one time supplied 60 per cent of the war requirements for acetone, was discontinued at the signing of the armistice. Methyl acetate and solvents for airplane dopes were no longer in demand and the process for the direct production of acetic acid was abandoned in favor of the byproduct acid. Ethylene has since achieved considerable commercial development as a gas for cutting and welding and as a standard chemical.

Thus at the end of 1918 we were like many other research organizations—going strong, but not in the right direction.

While the surveyors were staking out the site for the laboratory, a competent group of chemists were building up our equipment on the "state of the art." Every literature or patent reference, directly or indirectly related to our problems, in every country and

language was studied, translated if necessary, abstracted, classified, indexed and made available to the laboratory staff. This file now includes over forty thousand references kept strictly up to date. These searchers are in constant contact with the laboratory, supplying them with advance information, helping over the humps and bringing up the rear on patents. The department has since been expanded into a general information service for the entire business, including contemporary progress, commercial development, statistics, foreign relations, etc.

Qualifications of the Good Operator

Good operating chemists and engineers are in a class by themselves. Patience, caution and conservatism are not natural to a chemist who has been trained to visualize the invisible, to theorize and experiment. Too much imagination and inventiveness are qualities which if applied to a production operation will eventually wreck it. We prefer men who are hard headed, poker faced, unimaginative citizens, possessed of an obsession to make the wheels go round.

A good operating man will study every detail of his operation with a view to increasing its efficiency and output. This includes the efficiency and dependability of his operators. Each man, woman or boy in his subunits is studied to determine his or her fitness for the job. They must be made to fit the job or the job made to fit them. This leaves no room on the inside for misfits.

The operating chemist's problems are production, incessant production, quality and costs, including the costs of his losses of equipment, materials and time. If he has a burning desire to investigate something about a going process, let him take his problem to the research laboratory and keep it there till he gets the answer. Let him remember that the business of the plant is to produce and the business of the research laboratory is to experiment and develop, but that it takes a wiser man than he is to make the two function together and avoid the clutches of the sheriff.

Plant and Office Personnel

Plant offices are often neglected in spite of the fact that they are capable of being made one of the most necessary and important elements in a plant organization. They should be the connecting link between all internal units of the organization and between the organization as a whole and the public. Some office organizations, if allowed to drift, seem to have a genius for developing a high nuisance value and getting themselves disliked both inside and outside the plant. The exercise of a little common sense and some of the same care on the office personnel and its functions as that used on the development of research or operation will make an office staff what it should be—the pivotal point around which the whole finished organization will smoothly and noiselessly rotate. We believe that accountants, in addition to holding post-mortems on past performances, should supply *live* figures and facts designed to assist, direct and control going operations; that their costs need *not* be a blind assemblage of figures, but that they should reflect a working knowledge of the operation and what the costs ought to be—at least enough knowledge to enable them to get the decimal point in the right place. This policy means that the office becomes a working part of our research engineering construction operating organization and not the "short hour aristocrats" of the plant. Orders, billing and correspondence come in for their share of systematic attention and the "foreign relations" of the organization are handled with a minimum of "alibi building" and "buck passing."

Purchasing agents, in addition to their usual prerogatives of browbeating salesmen, are expected to function as advance agents for research and engineering, to know the stocks of materials and supplies in the

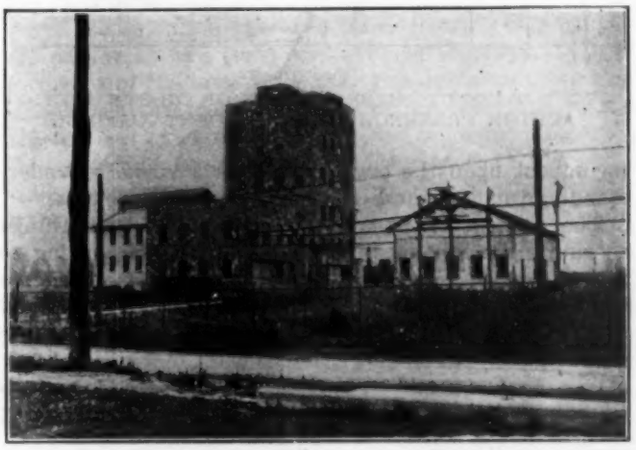


FIG. 2—EXPERIMENTAL DISTILLING TOWER AND FERMENTATION LABORATORY

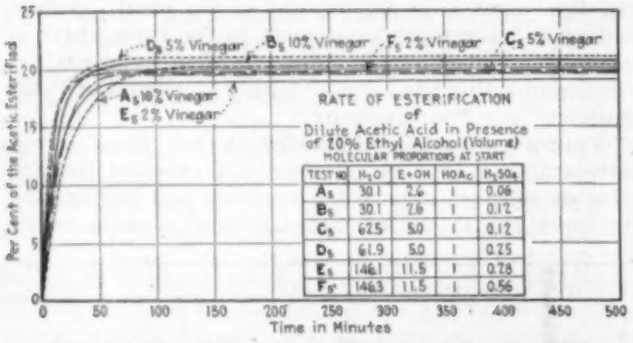
plant and to anticipate balance and look forward. Their job does not end with writing an order and dropping it in the mail, but they are expected to know when and where the goods will be delivered, see to it that they are delivered, that the stuff delivered is what was purchased and, more important, what it wanted, and finally, to see that the man who wants the stuff knows it is in and where it is to be found. This may look like a big contract, but it can be done and is being done wherever purchasing offices function according to our plan.

Having achieved the development of new products and processes and reached the point of production, the largest problem of all is sales. Unless proper attention has been given to the development of sales, which includes the promotion and introduction of the products to the trade, disaster awaits a budding chemical industry.

Sales development is a long and tedious process. It takes time and talent for a new producer to butt into an old market and it takes more time and more talent to introduce new products. New products must be guided through the introductory stages by the research laboratory and especially by those men most responsible for the development. This knowledge and paternal interest must be capitalized in order to furnish salesmen, even those with technical training, with the proper sales points and the necessary enthusiasm.

The Seasoning Process

General seasoning of a new organization is the most elusive and, therefore, the most interesting problem of them all. It has many discouraging and some mysterious features. Experience and patient hammering seems to be the solution if one can live through it. General plant sense, mechanical horse sense, legal liabilities as applied to purchase, sales and employment contracts, insurance, fire risks, employees, risks and safeguards, do not fall within the training and experience of the young plant chemist or engineer, yet it is



TEST NO.	H_2O	E+OH	HOAc	H_2SO_4
A_5	30.1	2.6	1	0.06
B_5	30.1	2.6	1	0.12
C_5	62.5	5.0	1	0.12
D_5	61.9	5.0	1	0.25
E_5	146.1	11.5	1	0.28
F_5	146.3	11.5	1	0.56

FIG. 3—RATE OF ESTERFICATION OF DILUTE ACETIC ACID IN PRESENCE OF 20 PER CENT ALCOHOL

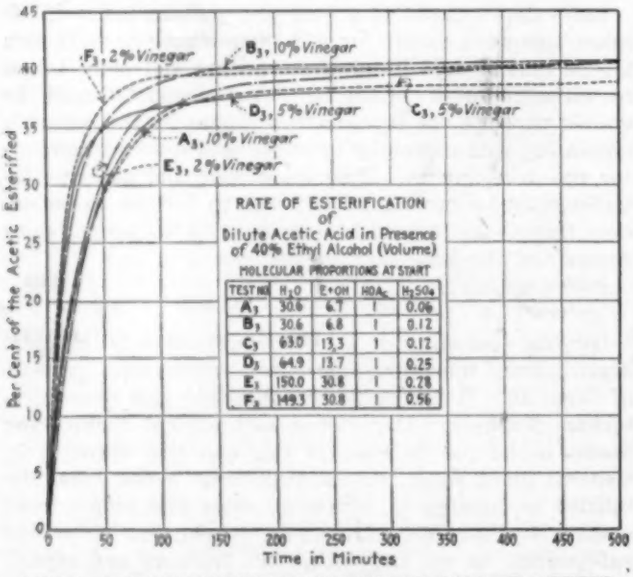
incumbent upon the organization as a whole to understand and handle these and many similar problems.

The element of mystery is involved in such things as running a suction pipe 65 ft. into a well, trying to push a loaded conveyor belt, installation of pipe sizes which add 100 per cent to 200 per cent of friction load to the normal head load of a pump, connecting operating units directly to underground sewers, omitting safety valves from steam jacketed equipment and trusting labor to function 100 per cent perfect. To the seasoned factory man, such things are hard to account for. Whatever may be the cause of these apparent lapses, continued hammering, an occasional steam roller and frequently some sad experiences seem slowly to wear down the list. In time men will learn to apply their physics, to think things through, to develop the "high points" in supervision so as to "just happen around" at a critical time, and finally to leave nothing to chance—to hold your aces at all times. No organization will ever be free from seasoning problems so long as we have the human element to deal with, but the "rate of frequency" may be used as a measure of perfection.

Ethyl Acetate

An Example of Organized Production

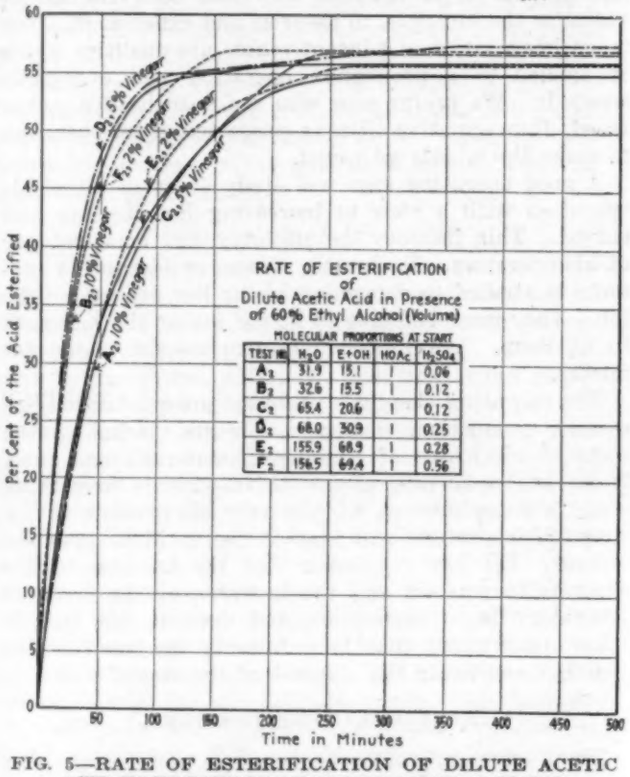
The foregoing general outline of the methods followed in organizing and preparing for chemical production would seem to require a specific illustration to show how the machinery works. This is probably best furnished by selecting a few steps followed in the development of our process for the continuous production of anhydrous, chemically pure, ethyl acetate directly from dilute solutions of acetic acid and alcohol.



TEST NO.	H_2O	E+OH	HOAc	H_2SO_4
A_3	30.6	6.7	1	0.06
B_3	30.6	6.8	1	0.12
C_3	63.0	13.3	1	0.12
D_3	64.9	13.7	1	0.25
E_3	150.0	30.8	1	0.28
F_3	149.3	30.8	1	0.56

FIG. 4—RATE OF ESTERFICATION OF DILUTE ACETIC ACID IN PRESENCE OF 40 PER CENT ALCOHOL

The production of ethyl acetate is not new and the literature is full of descriptions of the methods by which it is produced. All of these methods are based upon the theory that high concentration is required to bring about esterification and that in addition to the high concentration, a dehydrating agent, such as sulphuric acid, is necessary. The usual process, as you will recall, is the addition of high proof alcohol and sulphuric acid to dry calcium acetate, usually followed by prolonged refluxing of the mixture. Finally the ethyl acetate formed in the reaction, together with alcohol and acetic acid, is allowed to distill over and



TEST NO.	H_2O	E+OH	HOAc	H_2SO_4
A_2	31.9	15.1	1	0.06
B_2	32.6	15.5	1	0.12
C_2	65.4	20.6	1	0.12
D_2	68.0	30.9	1	0.25
E_2	155.9	68.9	1	0.28
F_2	156.5	69.4	1	0.56

FIG. 5—RATE OF ESTERIFICATION OF DILUTE ACETIC ACID IN PRESENCE OF 60 PER CENT ALCOHOL

is subsequently neutralized and refined by further distillation.

Our problem was to work large volumes of dilute acetic acid varying in concentration up to 15 per cent. Old standardized methods and materials were not available to us. Some new light had to be thrown on the chemistry of esterification and the properties of the products of these reactions.

Following the usual research practice and our abundant references to the state of the art, we made a few cut-and-try experiments on esterification. We played a few "hunches" as it were. These, as usual, resulted in nothing except to exert a sort of gyroscopic effect and to steady the boat. We determined, therefore, to make a basic study of the reactions between alcohol and acetic acid. This study included a careful investigation of the rates of reaction between alcohol and acid, equilibrium conditions, concentration of catalyzers, and various ratios of acetic acid and alcohol. Months were required to complete these investigations, but the facts once established presented an entirely new view of the problem, saved months of time in mistakes, or perhaps avoided final failure.

New Data on Alcohol-Acetic Acid Reaction

The results of these observations were carefully plotted and the following definite conclusions drawn from the facts disclosed:

(1) That there is a very definite reaction between acetic acid and alcohol in dilute solutions.
(2) That sulphuric acid in very low concentrations is an excellent and effective catalyzer for this esterification reaction.
(3) That the rate of reaction is comparatively high and is materially influenced by the concentration of the catalyzer.
(4) That the reaction is in general more than half completed in the first thirty minutes and has reached equilibrium in 150 minutes.
(5) That the equilibrium percentage of acid esterified for all conditions under consideration is determined solely by the concentration of the alcohol in the reacting mixture.
(6) That the old ideas, involving high concentration of the reacting materials, a dehydrator, refluxing, etc., in the ethyl acetate reaction, are a joke.

It is also an easy matter to draw some important deductions from the facts disclosed in these cases:

(1) That if the ester can be removed from the reacting mixture at the rate formed, without disturbing to a material extent the established conditions, it would be possible completely to exhaust the acetic acid in the form of ester.
(2) That having exhausted the acetic acid from the reacting mixture in the form of ester, the alcohol could be recovered by the usual exhausting process and the water residue, having no value, thrown away.
(3) That, assuming the physical facts would permit the removal of the ester from the reacting mixture without altering the conditions favoring the reaction, the operation could be carried on as a batch or as a continuous process.

The answer to the one open question brought out by the second deduction is found in the property of ethyl acetate to form constant boiling mixtures, as might be expected from its kinship to ethyl alcohol—an old offender in this respect. Little note is taken of these constant boiling mixtures in the literature on ethyl acetate processes, but Table I will show their importance to our line of reasoning.

TABLE 1—CONSTANT BOILING MIXTURES OF ETHYL ACETATE—ALCOHOL—WATER

Components	Boiling Point Deg. C.	Ester per Cent	Alcohol per Cent	Water per Cent
Ester, Alcohol, Water	70.3	83.2	9.0	7.8
Ester, Water	70.5	91.4	...	8.6
Ester, Alcohol	71.8	69.4	30.6	...
Ester	77.2	100.0	....	...

All of the curve deductions (see Figs. 3, 4 and 5), including the use of the properties of the constant boiling mixtures, and the relations of these to the solubility mixtures, were promptly put to the test of laboratory apparatus and confirmed.

We then turned to the design of a large scale experimental unit, utilizing some war equipment which was delivered months after the armistice, and junk. It had many misfit elements which did not meet even the calculated requirements of the basic data. It was far from mechanically perfect, and it leaked.

The Semi-commercial Unit

Nevertheless, this experimental unit served a very valuable purpose. It operated for several months and produced a product at a profit. It gave the engineers an opportunity to study the materials of construction, and the design. It gave the chemists a chance to find out some things about continuous operations of this character, which they had not heretofore known, for example: They expected to produce ester of high quality and free from aldehydes. They were unsuccessful in this until they discovered that a small amount of aldehyde was formed in the operation and carried into the finished product. The experimental unit gave opportunity to introduce a minor change which resulted in the accumulation of the aldehyde and its complete separation from the final product.

The experimental apparatus had a capacity of 300 to 400 gallons per day and was operated on a 24-hr. basis continuously for months at a time. During this period, the engineers had every opportunity to study the performance of the apparatus and to design a new machine embodying the ideal requirements as developed in the original investigations, and at the same time meeting the operating requirements as developed in the large scale experimental apparatus. In the meatnime, the market test showed the product of this process to be

FIG. 6—ETHYL ACETATE PLANT

exceptionally good. There was no difficulty in selling it or making it stay sold, and the demand for larger production was constantly increasing. We had reached this point in our work when one of our former associates, for whose opinions we had the greatest respect, but who had not kept up to date on our work, advised us that in his opinion we were "trying to drive a pile, a railroad spike and a tack with the same hammer in one operation."

The large scale designs were finally completed, put in the shops, erected and put into operation. (Fig. 5 shows plant.) This machine was kept under continuous observation by the research laboratory and the engineers for a period of over a year; daily reports in the form of operating logs were kept, not only for the guidance of the plant operating men, but also for the research chemists and engineers. These reports formed the basis of a subsequent complete re-analysis of the process and plant by the research laboratory for the purpose of establishing all facts and data that had developed in subsequent construction and operation, with a view to improving the design, materials of construction, operating features, etc.

The changes found necessary as a result of this re-investigation were very minor, and a second unit is now ready for operation which is almost an exact duplicate of the first. The monthly production of anhydrous chemically pure ethyl acetate by the continuous esterification of dilute acetic acid by this process is now over 150,000 gallons.

Research Bureau Laboratory Standard Steel Car Co.

By Richard Rimbach

THE Research Bureau Laboratory, located on the ground floor of the recently completed Cafeteria Building at the plant at Butler, Pa., embodies some of the best features of a number of laboratories visited by the metallurgist. Much of the apparatus, furniture and other equipment was specially constructed to his designs and specifications. In most cases this equipment was built in our own shops.

The laboratory has five units: A physical testing laboratory, a heat-treating laboratory, an experimental machine shop, a metallographic laboratory and a chemical laboratory. The disposition and character of the equipment as planned and installed insure the execution of all work with due economy of time and effort.

The physical testing laboratory, the heat-treating laboratory and the machine shop were combined, because this arrangement promises facility of operation.

The physical laboratory is equipped for all kinds of physical tests. It contains the following testing machines: A 200,000-ft. automatic and autographic universal testing machine; a 60,000-in.-lb. automatic and autographic torsion machine; a cold bend machine; a repeated impact machine; a vibratory machine; a slip abrasion machine; a 120-ft.-lb. combined impacct tension and cantilever notched bar bar-testing machine.

The heat-treating equipment is modern in every respect. The arrangement is excellent for research work, such as case-hardening and other heat-treating experiments. The equipment consists of two electric muffle furnaces and an electric carbon resistance high-speed furnace. A high-resistance double-scale wall mounting indicating pyrometer with an eight-point switch is used for reading the temperatures of the furnaces. The quenching is done in four tanks, each 2x3x25 ft. Two of the tanks are for oil, one for brine and the other for water. These are provided with wire baskets so that the specimens may be dropped as soon as they have been quenched. Water, air and steam jets are also arranged for hardening. A hood for taking away the fumes and heat is over all furnaces. A Brinell machine is used for checking the heat-treatments, as is also a scleroscope.

The machine shop is equipped with the machines necessary for the sampling and preparation of tests for physical testing, chemical and microscopic analysis.

Metallographic and Chemical Laboratories

The metallographic laboratory also serves as the balance room. It is equipped with thoroughly up-to-date apparatus, including an optical bench. The microscope is an important feature of the modern laboratory and no pains have been spared to make this one complete in every respect. The optical bench is mounted on a stand of drawers in which the photographic plates are filed. Experiments in pyrometry can be carried on in this room. For this purpose a work bench runs along one wall. The critical point machine is set up at one end of this work bench. The balance table is placed so as to be most convenient to the adjoining chemical laboratory.

The chemical laboratory has the equipment of a first-class analytical laboratory. The work tables are composed of alberene stone mounted on drawer and cupboard units. A hood unit 12 ft. long and 3 ft. wide is provided, the working table of which is covered with alberene stone. The hoods have not only the customary upper draft into the stack but also a lower draft. This draft is sufficient to pull out heavy fumes, which otherwise get into the room. It is supplied by an acid fume-resistant exhaust blower. The hood unit is divided into four compartments. One compartment is used for sulphur determination apparatus, one for phosphorus, one for dissolving samples and the last for testing fuels, oils and gases. Nearly all hot acid solutions are cooled under the hoods, and in a large measure the atmosphere of the laboratory is quite free from acid fumes. A large cabinet is placed at one end of the laboratory, for storing chemicals and glassware which are not used daily.

A shower bath head is placed in the chemical laboratory for extinguishing burning clothing or for diluting corrosive liquid splashes. It is provided with a chain fastened to a quarter turn valve so that the water may be released without difficulty in time of accidents. No drain is provided in the floor, as the use of this shower should be infrequent.

The service is piped above the tables and in the hoods. The tables and hoods are provided with numerous electric power plugs for the operation of motors, ovens and the like. The piping system comprises drains, oxygen, hot and cold water, compressed air, vacuum, gas, distilled water and high- and low-pressure steam. The pipes and fittings are painted with distinctive colors denoting their use, which makes it an easy matter to locate trouble. The color scheme used is given below:

Service	Color of Pipe	Color of Fittings
Acetylene	Black	Black
Compressed air	Yellow	Black
Electricity, 110 v., d.c.	Black	Red
Electricity, 220 v., d.c.	Black	Yellow
Electricity, 440 v., a.c.	Black	Green
Gas	Blue	Gray
Hydrogen	Blue	Blue
Oxygen	Yellow	Yellow
Pyrometers	Black	Gray
Vacuum	Green	Green
Water, cold	White	White
Water, hot	White	Black
Water, distilled	Glass	Rubber
Waste and sewage	Gray	Gray

The vacuum is furnished by a small vacuum pump, which starts and stops automatically.

There is also a storeroom for heavy chemicals, apparatus and miscellaneous supplies. This storeroom has a card system which is kept up to date, making it possible to tell the amount of material on hand at any time.

New Uses for Grain Sorghums

The grain sorghums, a comparatively new crop in the United States raised largely only for the feeding of farm animals, are now being used in increasing quantities for human food and various industrial purposes, according to the United States Department of Agriculture, and are receiving attention from the manufacturers of alcohol and starch. Feterita and milo, which contain on an average 65 per cent of starch, seem to be especially suitable as raw material for the manufacture of high-grade starch by commercial processes.

The results of a study on the physical characteristics and the chemical composition of milo and feterita have just been published in Department Bulletin 1129, by George L. Bidwell, Leslie E. Bopst, and John D. Bowling, Bureau of Chemistry. This study was made to provide a basis for the utilization of grain sorghums in the manufacture of starch and feeding stuffs, and to furnish data for engineers who may be called upon to design machinery for milling, all of which data are included in this bulletin.

Effect of Temperature On the Mechanical and Microscopic Properties of Steel

By George C. Priester and Oscar E. Harder

Assistant Professor Mathematics and Mechanics, and Associate Professor Metallography, University of Minnesota.

Properties of a Low-Carbon Steel in the Blue Heat Range Are Inherent to That Temperature and Are Not Duplicated When Same Metal Is Tested at Room Temperature After a Corresponding Tempering

THIS investigation was instituted early in 1920, and had for its purpose a study of the mechanical properties of steels at elevated temperatures, the properties of these same steels at ordinary temperature after having been heated to various drawing temperatures, and, finally, the correlation, in so far as possible, of these properties with the microstructure of the steels.

Previous Investigations

Recently published investigations on this subject include those by French,[1] MacPherran,[2] Spooner[3] and D'Arcambal.[4] French first investigated boiler plate of firebox and marine grades with carbon contents of 0.19 and 0.25 per cent respectively.

As a means of comparing these results Table I has been prepared. In it a ratio has been figured between the properties of these steels at room temperature and at that temperature which showed the maximum tensile strength. Some calculations are only approximate, because the values had to be taken from the published curves.

TABLE I—RELATION OF MECHANICAL PROPERTIES AT HIGH AND ROOM TEMPERATURE

Investigator	Carbon, Per Cent	Tensile Strength	Propor. Limit	Yield Point	Red. of Area	Elongation
H. J. French	0.19	1.13	0.66	....	0.80	0.68
	0.25	1.09	0.72	....	0.75	0.56
	0.38	1.10	0.73	0.54	0.54	0.74
Authors	0.16	0.98	0.89	0.98	0.92	0.96
R. S. MacPherran	0.13	1.22	....	....	0.83	0.57
	0.09	1.33	....	0.67	0.81	0.58
	0.41	1.03	....	....	0.85	0.53
	0.51	1.14	....	0.90	0.70	0.70
A. P. Spooner	0.10	1.25	....	0.78	0.85	0.66

It will be observed that the present authors have obtained a lower ratio for the tensile strength, but higher ratios for the other values. This can probably be attributed to the different heat-treatments, since we have tested the steel at room temperature in the hardened conditions, whereas other investigators have used annealed or drawn steels for their tests at room temperature.

Scope of the Investigation

The present investigation has included the following: Development of apparatus for determining the mechanical properties of steel at elevated temperatures; tests on hardened 0.16 per cent carbon steel to determine the maximum stress, proportional limit, yield point, reduction of area, and elongation at temperatures from 20 to 600 deg. C.; determination of these same properties on specimens which had been hardened, drawn at various temperatures from 100 to 600 deg. C. and tested at ordinary temperature; and the impact properties of specimens tested at ordinary temperature after hardening and subsequently drawing at various temperatures. There is also included the Brinell and scleroscope hardness values on the drawn specimens and the microscopic examination.

Hot-rolled steel ¾-in. diameter was used of the following chemical composition: C 0.16, Mn 0.46, S 0.034, P 0.009. All specimens were annealed after machining and before hardening in order to give a uniform structure. The various heat-treatments are discussed under the particular test to which they apply.

Tests at Elevated Temperatures

In order to make tests at elevated temperatures, a special apparatus was developed, a sketch of which is shown in Fig. 1. The temperature of the specimen was measured by a carefully calibrated thermocouple, the hot junction of which was clamped in contact with the lower shoulder of the specimen. The specimen was gradually heated to the desired temperature by means of the electric furnace and was held at that temperature for 30 minutes to establish thermal equilibrium. Under these conditions it is believed that any heat changes which took place during the testing of the specimen are negligible. It is believed that there can be no

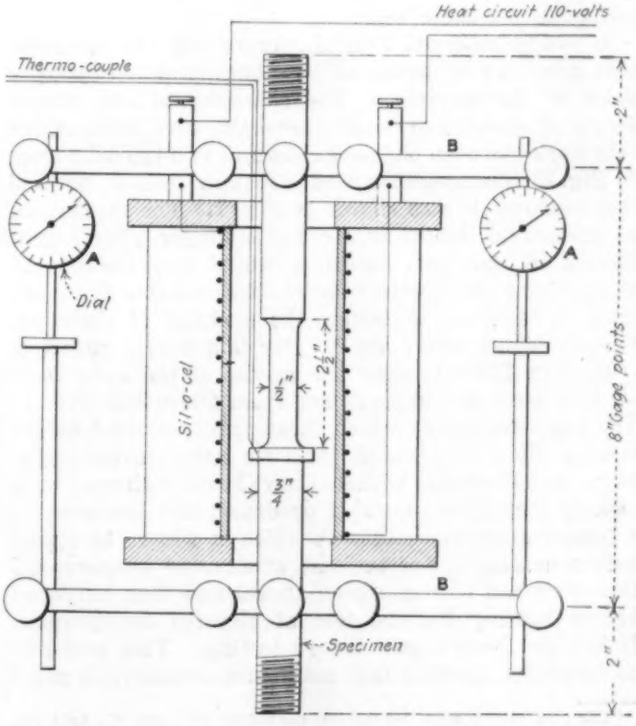


FIG. 1—SKETCH OF APPARATUS FOR MECHANICAL TESTS AT ELEVATED TEMPERATURE

[1] "Tensile Properties of Boiler Plate at Elevated Temperatures," *Mining & Met.*, February, 1920, No. 158, Sec. 15. Also in *Chem. & Met.*, 1922, vol. 26, p. 1207. Discussion of MacPherran's paper "Comparative Tests of Steels at High Temperatures," *Proc.*, A.S.T.M., vol. 21, pp. 861-3 (1921).

[2] "Comparative Tests of Steels at High Temperatures," *Proc.*, A.S.T.M., vol. 21, pp. 852-860 (1921). Also in *Chem. & Met.*, 1921, vol. 24, pp. 1153-55.

[3] Discussion of MacPherran's paper, *ibid.*, pp. 863-8.

[4] September meeting American Society for Steel Treating (1921). These results apply to tool steels, rather than material of low-carbon content.

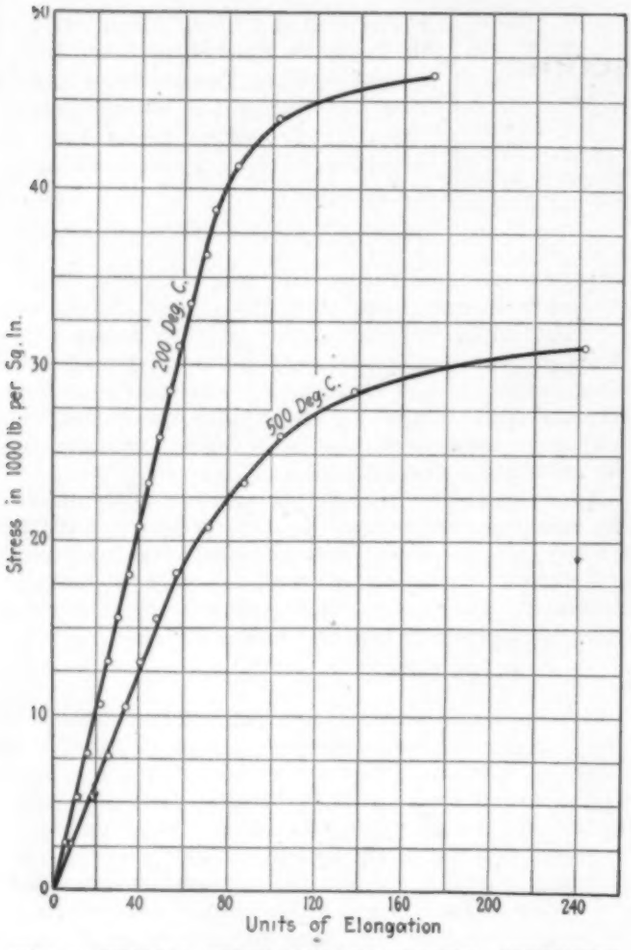


FIG. 2—TYPICAL STRESS-STRAIN CURVES; SPECIMENS QUENCHED FROM 910 DEG. C. AND THEN TESTED AT THE TEMPERATURES NOTED

question about the accuracy of the temperature measurements for these tests.

It will be observed from the figure that the extension was measured by means of two Ames dials on opposite sides of the specimen. The character of the stress-strain diagram and incidentally the care with which this work has been done are shown in two typical curves in Fig. 2. The specimen used in making tests at elevated temperatures is also shown in Fig. 1. The extensions, as measured, doubtless are for a longer gage length than 2 in., but this condition would only change the slope of the stress-strain curve, thus making it impossible to calculate accurately the modulus of elasticity, but would not affect any of the data herein reported.

Data in Table II show the results of the tests made on this steel at temperatures from 20 to 600 deg. C. The heat-treatments which these steels received before testing should be noted,[8] because some investigators have tested steels without any heat-treatment, and usually they have annealed or drawn the specimen at a temperature above that at which it was to be tested before heating it for the test at elevated temperature. Our steel had been given an anneal and then hardened before heating for the test at elevated temeprature. It had not been drawn before testing. This probably accounts for the fact that maximum stress, yield point

[8]The test pieces were machined, heated to 910 deg. C., held for 1 hour, cooled slowly in the furnace, reheated to 910 deg. C., held for 30 minutes, then quenched in ice water. The specimens were then placed in a testing machine as shown in Fig. 1, heated to the temperature shown, held at that temperature ½ hour and tested at that temperature.

TABLE II—EFFECT OF TEMPERATURE ON THE MECHANICAL PROPERTIES OF STEEL

Spec. No.	Temp., Deg. C.	Propor. Limit, Lb./Sq.In.	Yield Point, Lb./Sq.In.	Maximum Stress Lb./Sq.In.	Red. of Area, Per Cent	Elongation, Per Cent
3B	20	44,000	54,300	73,700	77.4	24.0
3A	20	46,400	54,000	74,200	77.2	31.5
5A	100	41,400	51,900	69,600	78.7	27.0
4B	200	39,000	52,000	69,700	75.7	32.0
4A	200	38,800	51,800	68,800	77.0	25.0
9A	250	38,300	51,000	70,000	75.0	25.5
1B	300	39,000	51,900	72,700	71.9	26.5
1A	300	41,400	54,300	72,700	69.7	27.0
8B	350	32,900	48,000	68,200	74.8	31.0
8A	350	35,200	50,300	70,300	74.2	29.0
2A	400	28,500	44,000	59,300	88.8	37.0
6A	500	18,100	31,100	42,700	93.6	38.0
7A	600	10,300	19,300	23,200	96.3	38.0

or proportional limit never exceeds the values obtained at ordinary temperature. However, there is a well-marked maximum in these curves clearly shown in Fig. 3 which is in good agreement with results found in previous investigations. The character of the fracture of these test specimens seems to be rather significant and these fractures are shown arranged in order of the increase in temperature from left to right in Fig. 4. The marked decrease in the maximum stress, yield point and proportional limit begins at about 350 deg. C., and this seems to be in general agreement with the breakdown in the microstructure (Figs. 6 to 13.)

Quenched and Tempered Steels

Specimens used for testing this steel after tempering correspond to the A.S.T.M. standard. Heat-treatment of the machined bar consisted in annealing 1 hour at 910 deg. C., furnace cooling; hardening in ice water after 30 minutes' soaking at 910 deg. C., then heating to the various drawing temperatures, holding at that temperature for ½ hour and then cooling in air to room temperature. Results of these tests are shown in Fig. 5.

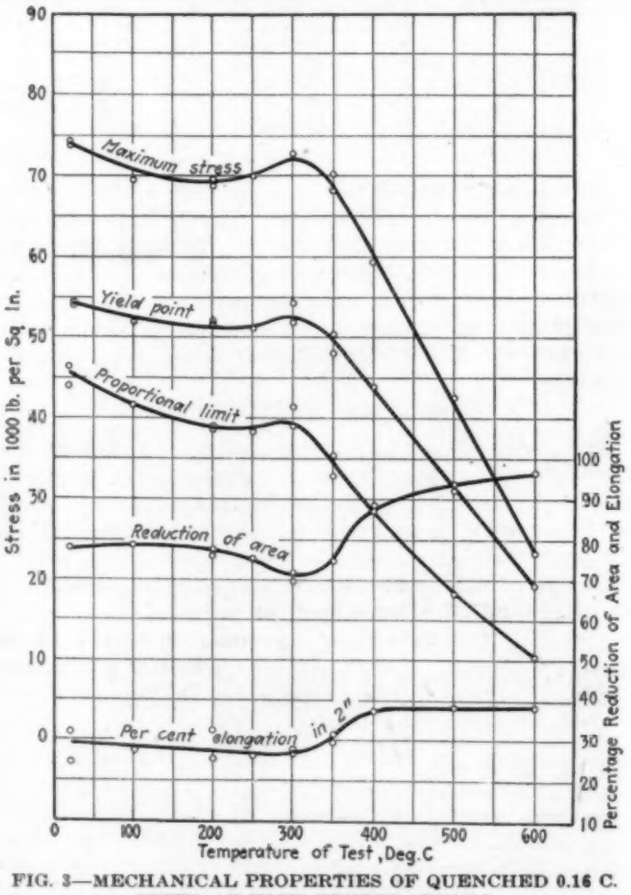


FIG. 3—MECHANICAL PROPERTIES OF QUENCHED 0.16 C. STEEL AT HIGH TEMPERATURES

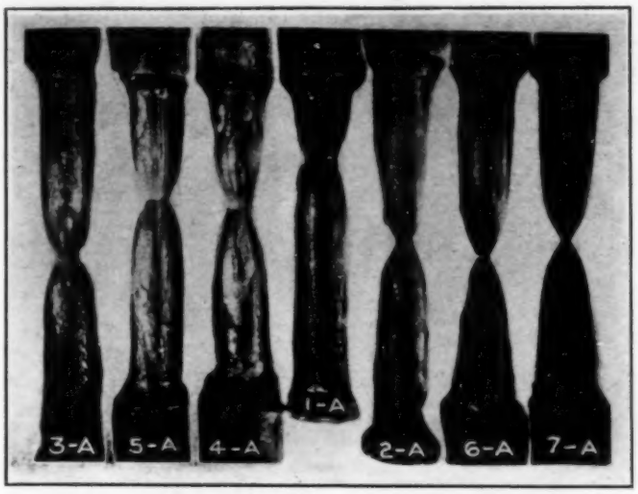


FIG. 4—FRACTURE OF SPECIMENS BROKEN AT HIGH TEMPERATURE (ABOUT HALF SIZE)

The mechanical properties—maximum stress, yield point, proportional limit, reduction of area and elongation—are approximately straight line functions of the drawing temperature. There are no maximum and minimum points which result from the steel having been drawn at 300 deg. C. This leads to the conclusion that the maxima and minima observed when the tests are made at elevated temperatures are due to the temperature at which the tests are made and not to the fact that the steel has been drawn at certain temperatures.

Impact Properties—The impact test data are shown in Table III. Tensile test specimens were turned down to 0.236 in. diameter between gage marks; the specimen

TABLE III—EFFECT OF DRAWING TEMPERATURE ON THE IMPACT PROPERTIES OF STEEL

	Impact Tensile Test				Notched Bar Impact Test	
Spec. No.	R.A. Per Cent	Elong. Per Cent	M.-Kg. Sq.Cm.	Ft.-Lb. Sq.In.	M.-Kg. Sq.Cm.	Ft.-Lb. Sq.In.
Annealed....	....	....	....	....	15.4	716
Annealed (*a*)	....	....	....	....	14.2	658
20	57.8	8.0	33.6	1,560	14.4	671
20A	63.2	12.5	45.4	2,120	13.9	645
100	48.9	5.5	26.0	1,220	14.7	684
100A	....	....	....	....	15.4	716
200	53.8	10.5	45.4	2,120	17.2	800
200A	55.3	6.0	32.5	1,520	16.7	781
300	66.7	13.5	45.2	2,090	17.6	819
300A	67.9	15.5	57.8	2,970	17.4	800
400	67.6	11.5	39.0	1,810	18.4	858
400A	70.0	13.5	48.0	2,230	18.0	839
500	72.8	22.0	71.5	3,330	19.2	890
500A	74.1	22.0	65.1	3,030	19.8	923
600	73.2	21.0	64.7	3,000	20.4	948
600A	74.3	23.5	67.0	3,240	20.3	942

was 4 in. long and the $\frac{7}{8}$-in. shoulders at each end were threaded clear up to the fillet. The results are erratic, but seem to indicate that the impact tensile, reduction of area and elongation show a minimum after a draw at 100 deg. C. There is then an increase in these properties up to about 500 deg. C. with possibly a little falling off after a draw at 600 deg. C.

Notched bar tests show a gradual increase with the increase in drawing temperature. The test pieces were notched before hardening (which is not the usual practice). They were 10 mm. square, 55 mm. long, notched at the center half way through. The notch was 1 mm. wide and had a round bottom.

Brinell and Scleroscope Hardness—Brinell and scleroscope hardness tests were made on the specimens which had been tested at elevated temperatures for their tensile properties. They had not only been drawn at the various temperatures shown but had also been stressed in tension at those temperatures. The data from the hardness tests are given in Table IV and are shown graphically in Fig. 5. The results are averages of at least five tests on the individual specimen. The effects of drawing temperatures on these values are in general agreement with the effects on the tensile properties of these specimens at high temperatures (shown in Fig. 3) rather than when tested in tension after a draw. However, there are observed peaks in the curves for the Brinell and scleroscope hardness curves at draws of 200 and 350 deg. C. respectively. No explanation is offered for this phenomenon.

TABLE IV—EFFECT OF DRAWING TEMPERATURE ON THE HARDNESS OF STEEL

Drawing Temperature..	20	100	200	250	300	350	400	500	600
Brinell.....	148	143	146	....	143	....	142	137	131
	147	146	149	....	145	....	140	134	128
Average.....	148	144	148	....	144	....	141	136	130
Scleroscope.....	41.0	40.0	38.0	38.4	41.6	41.4	37.3	33.1	30.1
	38.5	....	39.5	....	39.6	41.7	....	....	....
	....	....	....	....	38.6	40.3	....	....	....
Average.....	39.8	40.0	38.8	38.4	39.9	41.1	37.3	33.1	30.1

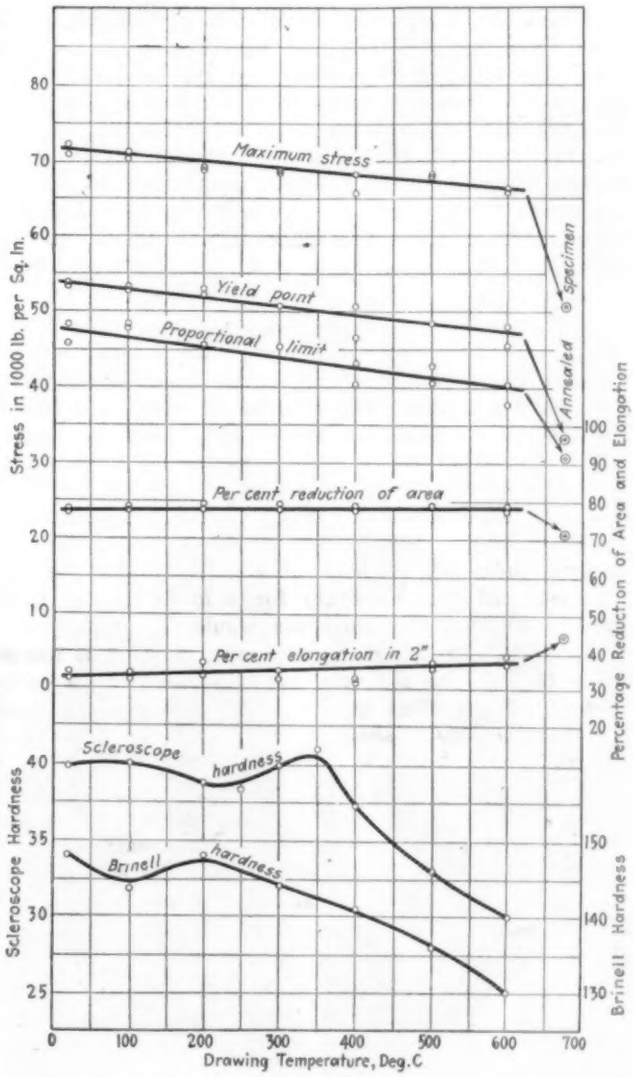
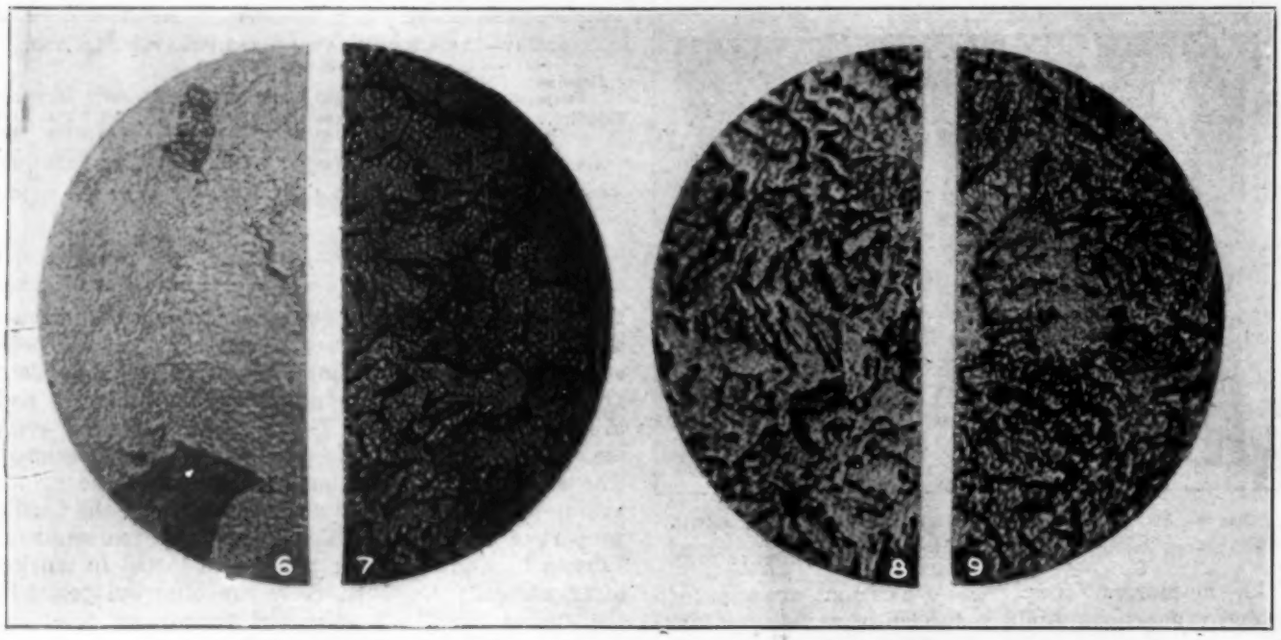


FIG. 5—PROPERTIES OF QUENCHED AND TEMPERED 0.16 C. STEEL



FIGS. 6 TO 9—STRUCTURE OF STEEL. ETCHED WITH PICRIC ACID. × 1,000
Fig. 6—Annealed. Fig. 7—Quenched from 910 deg. C. Fig. 8—Drawn at 100 deg. C. Fig. 9—Drawn at 200 deg. C.

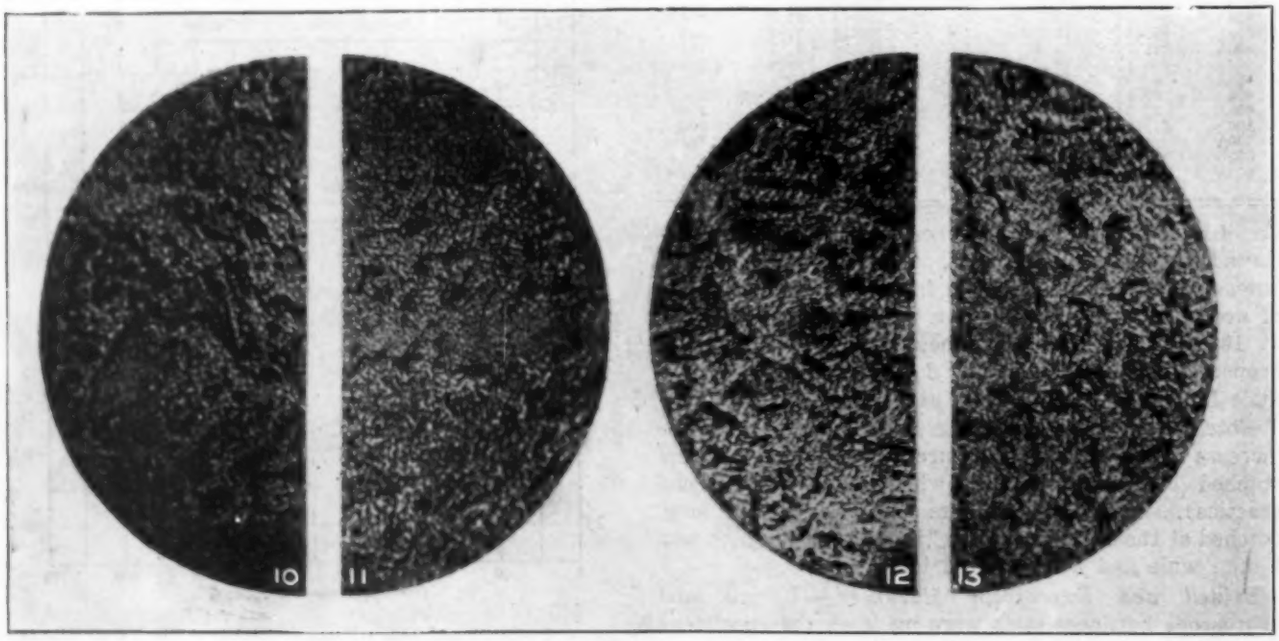
Microscopic Examination—Microscopic examinations of the specimens which had been drawn at various temperatures show first of all that the hardened specimens still contained some free ferrite and are reproduced in Figs. 6 to 14 inclusive. The amount and distribution of ferrite seems to be fairly uniform in the different specimens. There is an indication of a breakdown in the hardened areas at the higher draw, particularly at 400 to 600 deg. C. It is difficult to get satisfactory etches on hardened steel of this low carbon content.

Conclusions

(1) Plain carbon steel containing 0.16 per cent carbon, when tested at temperatures ranging from 20 to 600 deg. C., shows a maximum in the maximum stress, yield point and proportional limit curves at about 300 deg. C.; however, these values do not exceed the corresponding values at 20 deg. C. It shows a minimum in the reduction of area curve at approximately this same temperature, with a less pronounced minimum in the elongation curve.

(2) These changes in the physical properties are due to the temperature at which the test is made and are not the result of the steel having been drawn or tempered at a certain temperature. This is shown by the fact that when this steel is drawn, then cooled to ordinary temperature and tested, there is no maximum or minimum observed in the curves.

(3) Above about 300 deg. C. the minimum stress, yield point and proportional limit decrease almost as a straight line function of the temperature at which



FIGS. 10 TO 13—STEEL, QUENCHED AND DRAWN. ETCHED WITH PICRIC ACID. × 1,000.
Fig. 10—Drawn at 300 deg. C. Fig. 11—Drawn at 400 deg. C. Fig. 12—Drawn at 500 deg. C. Fig. 13—Drawn at 600 deg. C.

the test is made, and the effect on the maximum stress is the most pronounced. There is a corresponding increase in the reduction of area and elongation, but the elongation is approximately constant above 400 deg. C.

(4) The impact toughness increases with the drawing temperature and appears to be nearly a straight line function of the drawing temperature.

The results of the impact tensile tests show a slight decrease in the tensile strength, reduction of area and elongation for specimens drawn at 100 deg. C. At higher drawing temperatures these values increase with increase in the drawing temperature.

(5) Microscopic examination shows changes in the microstructure which correspond to the changes in the mechanical properties at the higher temperatures (400 to 600 deg. C.), but do not seem to throw any light on maximum and minimum points in the curves for tests at 300 deg. C.

Recent Work on the Separation of Isotopes*

THE SEPARATION of isotopes is of timely interest, inasmuch as Dr. Aston and Professor Soddy have just been awarded the Nobel prize for their work in this connection. It was Soddy who gave the name to isotopes and who began his work in 1914. Aston's work is later, and has to do with those of common elements.

It would be as difficult to answer the question "what is an isotope?" as it would be to expound the problem "what is a scissor?" or "what is a trouser?" They are indeed atomic twins, triplets, quadruplets and even sextuplets and octuplets. Isotopes of an element have substantially all properties in common except atomic weight. Isotopes of chlorine have, for example, masses respectively of 35 and 37. Six have been found of mercury and eight of tin. On the other hand, oxygen nitrogen, carbon and hydrogen appear to be homogeneous, and have only one atomic weight; to be, therefore, without isotopes.

The whole thing is revolutionary, in that it attacks the chemist in his most sensitive spot, where his most painstaking work has been carried on—his table of atomic weights. It makes his meticulous fractions mere averages of mixtures of isotopes of which the mass of each is indicated by a whole number. On the other hand, it connects up and coincides in a remarkable manner with the Lewis-Langmuir theory of atomic and molecular structures. Aston's deductions, like Langmuir's, may be wrong, but it is hard to deny them in the face of such an overwhelming flood of coincidences as is found in support of them.

Aston's Process of Separation

The Aston method of procedure consists, first in obtaining the positive rays of a given material by the adoption of a modification of Sir J. J. Thomson's method of positive ray analysis. The material is first ionized by X-rays and passed through a fine slit, giving a narrow ribbon of rays. These are then passed between positive and negative poles which deflect the positive rays in the direction of the negative pole. Passing now through a diaphragm the positive rays are again deflected by a magnet, so that they strike a photographic plate. If, then, all rays have the same mass they should strike the plate at the same spot. Aston's experiments show this to be the case with elements which have atomic masses of whole numbers based on oxygen as 16. An oxygen gives only a single mark. Those having fractional atomic weights give more than one line, as, for instance, chlorine which gives one line at exactly 35 and another at 37, the line at 35 being three times as strong as that at 37. Neon shows a line at 20 and one at 22, but that at 20 is ten times brighter than the one at 22. He tested out carbon monoxide in the same way, and got bands at 28, at 12 and at 16. Carbon and oxygen show no isotopes, but the undissociated positively charged CO went just where it belonged, to 28. He made a great number of tests and reached the conclusion already given, that with oxygen as 16 every element that shows a fractional atomic weight consists of isotopes having masses of whole numbers, while every element with a whole number for its atomic weight with oxygen as 16, is homogeneous, i.e., it has no isotopes.

The Ionic Migration Method

The principle of the moving boundary is here being utilized. An agar-agar gel containing a chloride is inserted as a short middle section in a long horizontal tube, being preceded by a gel containing a faster anion (hydroxide ion) and followed by a gel containing a slower anion (acetate ion). When a current is passed, the boundaries between the solutions remain perfectly sharp, and the chloride moves slowly toward the anode. Now tubes of hydroxide gel are inserted before it reaches its goal, and after it has traveled, say, 100 ft., the chloride gel is sectioned and analyzed. If Cl(35 and Cl(37) possess different mobilities, the front section should contain only the one isotope, the second section only the other.

The Discharge Potential Method

Although the free energy charges involved in the separation of an electron from isotopic ions such as Cl(35) and Cl(37) are not necessarily identical, owing to the different constitutions of their nuclei, it is unlikely that the discharge potentials of the reaction: $2\,Cl^- \rightarrow Cl_2 + 2$ minus will be *appreciably* different in the two cases, when expressed in volts. What is more important than any possible *intrinsic* difference is the fact that in the natural isotopic mixture the concentration of $Cl^-(35)$ is more than 3 times that of $Cl^-(37)$. Provided the familiar Nernst E.M.F. equation applies, therefore, the discharge potentials of the two ions *in any solution* should differ by about 0.03 volts. If now we can adjust our current so that it is just above the decomposition potential of one ion, and just below that of the other, and if we can withdraw the discharged products immediately, then a perfect separation should be possible. Possibly the utmost that will be obtainable in practice, will be an "electrolytic fractionation."

The experimental details are now being developed and perfected, before actual runs are made. Mercury, magnesium and lithium are under investigation in the connection, as well as chlorine.

The Freezing Point Method

Although attempts to separate other isotopes by analogous methods have not succeeded in the past, it is possible that in an extreme case such as Li(6) and Li(7), where the atomic masses vary by 16 per cent, an appreciable difference in the points of fusion of the pure isotopes will exist, and so permit a separation by fractional crystallization. This method is being tested out at the present time, with lithium and potassium.

*Résumé of a talk by Dr. James Kendall, of Columbia University, before the New York Section of the American Chemical Society Dec. 8, 1922.

Ethylene as a Source of Alcohol

A Study of the Distillation Gases Yielded by Trent Amalgams, With Special Reference to Their Unsaturated Constituents*

By J. D. Davis
Research Chemist, Pittsburgh Experiment Station.
U. S. Bureau of Mines

SIXTY years ago M. Berthelot found that ethylene could be selectively absorbed from gaseous mixtures by concentrated sulphuric acid and that the compound formed by the chemical union of the gas and acid was readily decomposed by heating with water, yielding ethyl alcohol. Only within the last few years has there been any attempt to make use of this discovery technically. Bury[1] working in England at the Skinningrove Iron Works and on a commercial scale, developed a technical method for converting the ethylene of coke-oven gas into alcohol. With a gas containing less than 3 per cent of ethylene, he obtained a yield of 1.6 gal. of alcohol per ton of coal carbonized.

De Loisy[2] perfected a technical method for treatment of coke-oven gas for alcohol. Evidently this work was carried out on a semi-commercial scale. His method is based on the use of catalytic agents for hastening the absorption of ethylene by sulphuric acid. He uses part of the spent acid for drying the gases and part for the manufacture of ammonium sulphate. Excess acid is reconcentrated by waste heat. Others have worked on the problem, but so far there has been no large recovery of ethylene from coke-oven gases. The chief difficulty seems to lie in the low efficiency (about 50 per cent) of methods and the relatively low concentrations of ethylene in the gases treated. Gas from Trent amalgam[3] contains much larger percentages of ethylene than does coke-oven gas, as will presently be shown, and if it should ever prove practical to treat industrial gas for alcohol, this gas would offer attractive possibilities.

Carbonizing Trent Amalgams

The method used here to carbonize the amalgams differs from any now used for the commercial carbonization of coal. In ordinary practice, coal charges are distilled at all temperatures from the decomposition point of the coal to the highest retort temperature, and no definite temperature can be fixed on as the temperature of distillation. With the method here used, the distillation range was made narrow. This was effected by feeding the charge regularly into a retort kept at constant temperature—that is, the predetermined distillation temperature. Distillations were conducted at temperatures 400, 500, 600, 700 and 800 deg. C., and the gases evolved were measured and analyzed. Samples of the coal and oil used to prepare the amalgams were distilled under the same conditions as were the amalgams for purposes of comparison.

TABLE I—CHARACTER OF MATERIALS USED

Big Muddy Coal

	Per Cent
Moisture	5.78
Volatile matter	31.87
Fixed carbon	52.42
Ash	9.93
Total	100.00
Sulphur	1.28

Fractionation of the Navy Fuel Oil

Temperature Range Deg. C.	Per Cent Distilling
130	First drop
130 to 225	1.1
225 to 250	4.83
250 to 275	14.25
275 to 300	20.10
300 to 325	21.70
325 to 350	30.90
Residue	5.82
Loss	1.31
Specific gravity of the oil at 20 deg. C.	0.868

Experimental Results

The materials used in the experiments were Illinois coal obtained from the Big Muddy Coal & Iron Co., Herrin, Ill., and an asphaltic base fuel oil. An analysis of the coal is given in Table I, which also shows the fractionation results for the oil. Table II gives the analyses of gases evolved from amalgam, coal and oil at temperatures 400, 500, 600, 700 and 800 deg. C., together with total yields of gas and light oils scrubbed from the gas. Results for the 700 deg. amalgam run are not reported, owing to the fact that precipitated carbon clogged the mains and rendered the gas samples taken of doubtful value.

In general, the oils give higher yields and richer gases; the amalgams give somewhat less gas of poorer quality; and the coals give the lowest yields and the poorest gas. It is an interesting fact that the run at 800 deg. C., (with continuous feed) gave almost as much gas for the amalgam as for the oil, and gave a gas of slightly better quality. It thus appears that at

TABLE II—ANALYSES OF GASES FROM TRENT AMALGAMS, COAL, AND OIL

Charge	Temp. Deg. C.	CO_2	C_2H_4	O_2	Co	CH_4	C_2H_6	H_2	N_2	B.t.u. Per Cu.Ft.	Yield, Cu.Ft. Per Ton	Oil From Gas, Gal. Per Ton	Remarks
Amalgam	400	9.8	23.4	0.6	4.0	29.1	17.3	8.9	6.9	1,000	750	0.38	
Coal	400	17.9	0.5	0.4	11.7	46.7	0.0	17.4	5.4	550	980	1.5	
Oil	400	15.5	16.6	0.0	1.0	23.2	39.1	4.6	0.0	1,182	600	0.0	
Amalgam	500	3.0	17.0	0.0	5.3	37.4	12.0	25.0	0.3	937	4,470	3.0	
Coal	500	10.2	1.2	0.6	19.7	38.4	8.5	12.2	8.6	779	2,970	0.1	
Oil	500	0.6	39.6	0.4	0.5	29.3	24.1	2.9	2.6	1,353	5,300	2.6	
Amalgam	600	3.0	8.8	0.6	8.7	50.8	0.0	25.3	2.8	730	10,650	8.4	Continuous feed
Amalgam	600	3.3	13.6	0.6	7.5	49.4	0.0	23.9	1.7	794	5,650	3.6	Batch distillation
Coal	600	4.7	3.3	0.5	11.4	30.6	0.0	46.2	3.3	525	6,430	4.5	
Oil	600	1.8	31.0	0.5	1.8	46.3	10.8	5.0	2.8	1,167	16,900	11.1	
Amalgam	700	....	....	....	....	....	....	....	....	....	....	....	Gas samples uncertain
Coal	700	6.4	0.6	0.5	28.1	13.0	0.0	46.9	4.5	370	10,750	2.1	
Oil	700	0.4	23.2	0.5	0.5	63.6	2.0	8.3	1.5	1,056	19,320	7.0	
Amalgam	800	4.9	8.9	0.7	6.7	35.3	8.1	31.5	3.9	757	19,800	4.1	Continuous feed
Amalgam	800	4.7	6.1	0.0	7.9	32.9	5.4	36.9	3.4	654	3,400	20.2	Batch distillation
Coal	800	4.2	3.0	0.4	16.5	26.6	0.0	45.4	3.9	496	10,000	0.55	
Oil	800	2.1	2.2	0.0	1.6	63.7	0.0	28.2	2.3	710	20,050	2.1	

*Report of Investigations, Serial No. 2413.

[1] Bury, Ernest, "Ethylene as Alcohol From Coke-Oven Gas," *Gas Journal*, vol. 148, Dec. 30, 1919, p. 718.

[2] De Loisy, M. E., "Sur un procede' industriel de fabrication synthetique de l'alcool et de l'ether a partir des gaz de distillation de la houille," *Comp. rend.*, vol. 170, January, 1920, pp. 50-3.

[3] A paste consisting of approximately 2 parts finely pulverized coal and 1 part oil such as that obtained as a final product in the Trent process for cleaning coal. See Perrott, G. StJ., and Kinney, S.P., "The Use of Oil in Cleaning Coal, *Chem. & Met.*, vol. 25, Aug. 3, 1921, p. 182.

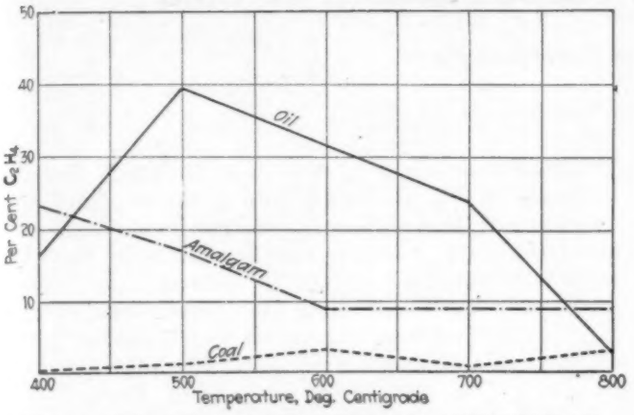


FIG. 1—PER CENT OF ETHYLENE IN GASES FROM OIL, AMALGAM AND COAL

this temperature Trent amalgam is just as good material for making commercial oil gas as the oil itself. The amalgam would of course be the cheaper, and further, it will be noted that under these conditions more oil was scrubbed from the amalgam gas than from the oil gas. Of course if a rich oil gas is wanted, the best procedure is to crack the straight oil at a lower temperature.

The percentages of oxygen-containing gases for the coals and amalgams are considered somewhat high. This is due partly to the method of feeding the retort and partly to the fact that the coal used was of high oxygen content. As for the first cause, the charge fed was finely divided, and must have carried into the retort a fair amount of adsorbed air.

Unsaturated Gases—The percentages of unsaturated gases are uniformly higher for the oil except with the run at 800 deg. C., where the amalgam gives the highest percentages. The coals give the lowest percentages of unsaturated gases, but slightly higher, perhaps, than would be obtained by commercial methods of carbonization. The amounts of these bodies found for the amalgams are intermediate between those for the oil and coal. Unsaturated gas is reported here as ethylene (C_2H_4), and it is probable that 95 per cent of it actually was ethylene. Especially is this true when it is considered that the gas had passed a charcoal scrubber, which would have a tendency to remove heavier gases.

Yields of Unsaturated Gases From Amalgams—Table III gives the yields of unsaturated gases from amalgams at the corresponding temperatures of distillation,

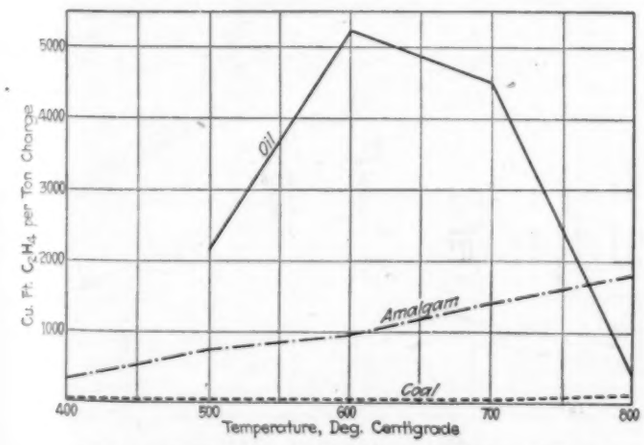


FIG. 2—YIELD OF ETHYLENE IN CU.FT. PER TON OF CHARGE

TABLE III—YIELDS AND ALCOHOL EQUIVALENTS OF UNSATURATED GASES FROM AMALGAMS

Temp. Deg. C.	C_2H_4 Per Cent	Total Gas Cu.Ft.	C_2H_4 Cu.Ft.	Alcohol Equivalent Gal. Per Ton
400	23.4	750	172	3.1
500	17.0	4,400	760	13.8
600	8.8	10,850	955	17.3
800	8.9	19,800	1,760	32.0

and their equivalents in alcohol, assuming complete recovery. Figs. 1 and 2 show the data graphically. As a basis of comparison of yields we may take Bury's[1] figure of 1.6 gal. of absolute alcohol per ton of coal charged in byproduct ovens. Assuming a 50 per cent recovery, this would mean a possible yield of only 3.2 gal. of absolute alcohol per ton of coal from coke-oven gas, whereas from Trent gas there is possibly from 3 to 32 gal. per ton of amalgam charged. It would thus seem that Trent gas is ideal (second only to oil gas) for the application of an alcohol recovery process.

Recovery of Ethylene as Alcohol—So far it has not been possible to recover from coke-oven gas more than 50 per cent of ethylene contained as alcohol, but it would undoubtedly be possible to improve this figure considerably by research. The problem offers possibilities, particularly in connection with the rich Trent gas. For example, De Loisy found that he could increase considerably the speed of absorption of ethylene by sulphuric acid through the use of catalytic agents, and thereby increase the recovery of alcohol.

Loss of Heating Value Through Removal of Ethylene From Gases—Table IV shows that the loss of heating value suffered by Trent amalgam gases on removal of the ethylene is not an important consideration. They are rich gases to start with, and the removal of ethylene, although that gas has a high heating value, does not bring their heating value below that of the best industrial gases.

TABLE IV—EFECT OF REMOVAL OF ETHYLENE ON THE HEATING VALUES OF TRENT AMALGAM GASES

Distillation Temperature, Deg. C.	B.t.u. Per Cu.Ft. Raw Gas	B.t.u. Per Cu.Ft. Scrubbed Gas
400	1,000	798
500	936	795
600	726	639
800	757	671

It may be stated further that the ethylene in the composite gas has a market value much below that which it would have as pure gas. For example, (see Table III) a 600 deg. distillation will yield 10,850 cu.ft. of composite gas, 955 cu.ft. of which is ethylene. The ethylene if recovered commercially pure would be worth 1 cent per cubic foot, or $9.55, whereas all the gas (at 50 cents per 100) would be worth about $5.40.

Flaky Fractures in Tool Steel

In connection with an extended investigation of high-speed tool steels now under way at the Bureau of Standards a number of treatments were applied to a single heat of high tungsten, low vanadium steel to determine whether so-called fish scale or flaky fractures could be produced intentionally, irrespective of the quality of metal as has been claimed. Normal fractures were obtained, however, in all cases, but these tests will be supplemented by further work with steels of questionable quality.

The Low-Temperature Carbonization of Coal

III.—The Clinchfield Carbocoal Plant

By Harry A. Curtis and Earle E. Daughton

THE Carbocoal process, as finally developed at Irvington, N. J., consisted of the following steps:

1. Crushing the coal and carbonizing it at a relatively low temperature in primary retorts provided with means for agitating the coal and advancing it continuously through the retorts.

2. Grinding the carbon residue, fluxing it with pitch, and briquetting.

3. Carbonizing the briquets at a relatively high temperature in secondary retorts to harden them and render them smokeless. The experimental plant at Irvington grew to be a semi-commercial installation before the work there was discontinued, but the plant was never put on a purely production basis. In September, 1918, ground was broken for a commercial Carbocoal plant at Clinchfield, Va. This plant was a government war project, but after the armistice construction was completed by the International Coal Products Corporation and the plant finally put into operation late in June, 1920. Not all of the units were finished at this time, but they were completed during the next few months.

General Arrangement and Equipment of the Plant

The Clinchfield Carbocoal plant has been described in several technical journals during the past 2 years.[1] There will therefore be included in the present article only such brief mention of the general features of the plant as will contribute to an understanding of the operating problems discussed later.

The general layout of the plant is shown diagrammatically in Fig. 1. In addition to the buildings, etc., appearing in this sketch, the company owns and operates a village for its employees, the plant being located in an isolated mountain district of southwestern Virginia.

The coal to be carbonized is dumped from railroad cars into a track hopper, carried on a Link-Belt apron conveyor to a Williams No. 3 hammer mill and crushed to pass a ¾-in. bar screen. It is then elevated by a Link-Belt bucket elevator to the top of the primary retort house and distributed by a flight conveyor to steel coal bins supplying the retorts. The capacity of this coal-handling equipment is, roughly, 50 tons per hour.

The primary retorts are of the type described in the first paper of this series.[2] For convenience a sketch of this retort is reproduced as Fig. 2. Twenty-four such retorts are arranged in four batteries, with the feed ends of the retorts turned together so that one coal bin serves four retorts, and a 50-hp. motor drives the feed screws and paddle shafts on twelve retorts. The carbon residue from the "Vesuvius" discharge falls on rubber-covered conveyor belts and is carried to the grinding mills, one belt serving twelve retorts. The scrubber standpipe from each retort carries the foul gas into a common main leading to the byproduct house.

The carbon residue was originally ground in Williams No. 3 hammer mills, two of these being installed underneath the carbon residue storage bins. It was found, however, that the hammers on these mills would last

[1] Article by Brandegee, *The Black Diamond*, July, 1920, describes the plant in some detail.

[2] *Chem. & Met.*, vol. 28, No. 1, p. 11, Jan. 3, 1923.

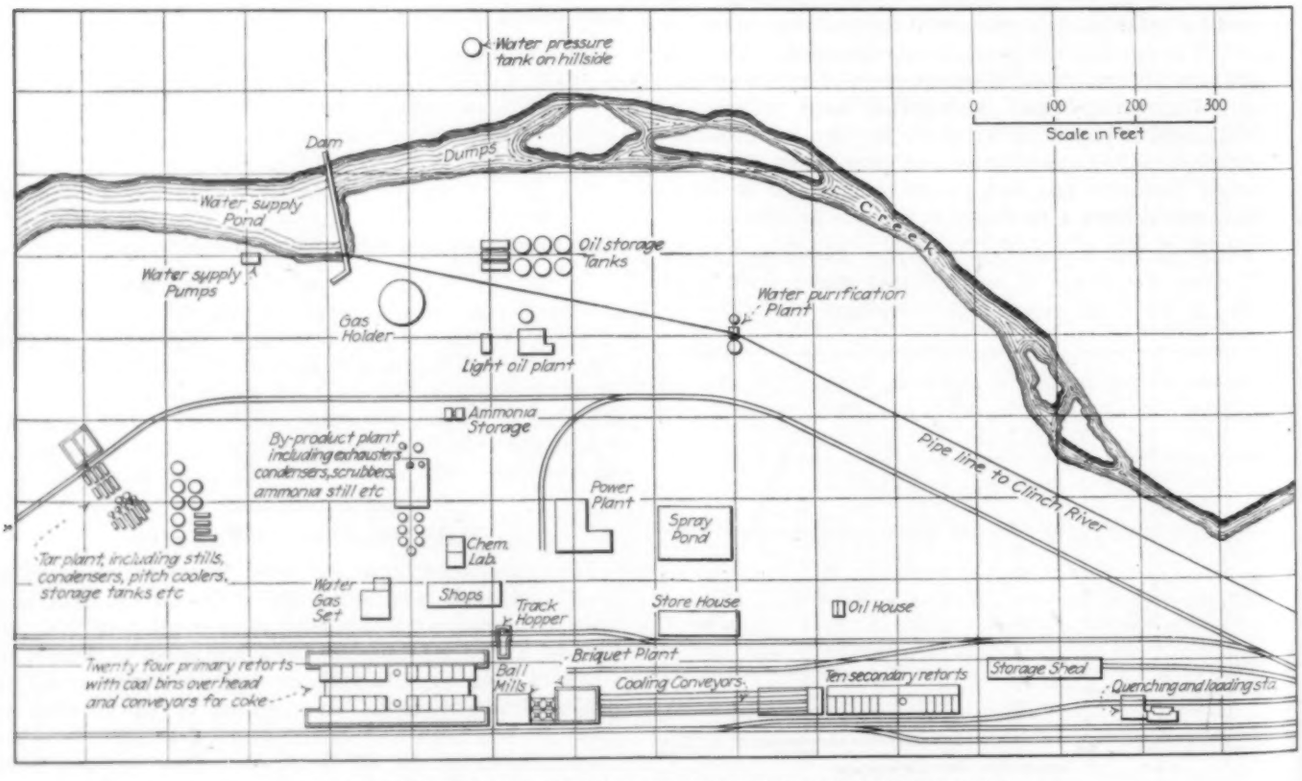


FIG. 1—GENERAL LAYOUT OF CLINCHFIELD CARBOCOAL PLANT

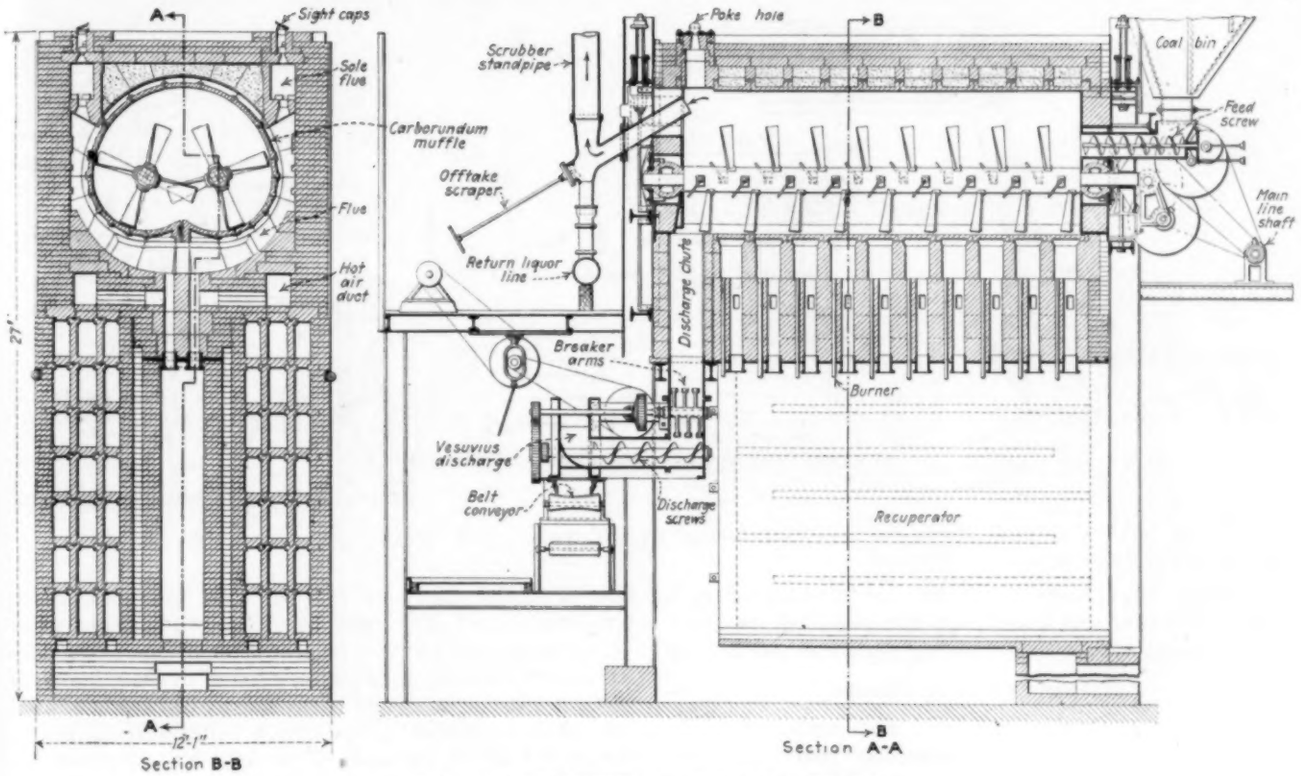


FIG. 2—CLINCHFIELD PRIMARY RETORT

only about 24 hours. Finally the mills were abandoned and a ball mill installed ahead of the storage bins. After grinding, the carbon residue is elevated to storage bins; from the bottom of these bins it is fed by a drag-chain proportioning conveyor to a bucket elevator, and delivered to a horizontal paddle mixer, where it is mixed with molten pitch. The paddle mixer empties into a fluxer, where the material is stirred and is heated with live steam. The fluxer empties by gravity into a second paddle mixer feeding the briquet presses. All of the grinding, elevating, mixing, fluxing and briquetting equipment is installed in duplicate units, each having capacity sufficient for the whole output of the primary retorts. The briquet presses are of the roll type with flat-link chains running between the molds so as to give briquets with flattened ends.

The warm briquets from the presses fall onto long, metallic chain-belt, cooling conveyors and are carried slowly up to a raw briquet storage bin. From the bottom of this bin the raw briquets are withdrawn over a shaker screen into a steel larry car serving the secondary retorts.

There are thirty secondary retorts arranged in ten benches of three retorts each. The retorts are divided into an upper and lower chamber by a silica brick partition, the chambers opening into each other at either end. Fig. 3 shows the general features of a secondary retort. The retorts are heated by vertical flues between them, with gas burners at the top of the flues. The lower ends of the flues open into a common duct passing up along the floor of the lower retort chamber and leading to the recuperator.

In these secondary retorts the briquets are carbonized for 8 to 10 hours, at a temperature which eventually reaches about 1,800 deg. F., the byproducts from this carbonization being collected and handled along with those from the primary retorts. At the end of the carbonizing period the discharge door at the lower end of the retort is opened and the briquets permitted to run out, the charge being poked with rods from the lower end if it hangs in the retort. The red hot briquets are quenched under a water spray, screened and loaded for shipment. In Fig. 4 there is shown a diagrammatic representation of the whole Carbocoal process, indicating the individual units.

The plant includes, besides the usual byproducts equipment, a tar plant, power plant, light oil refinery,

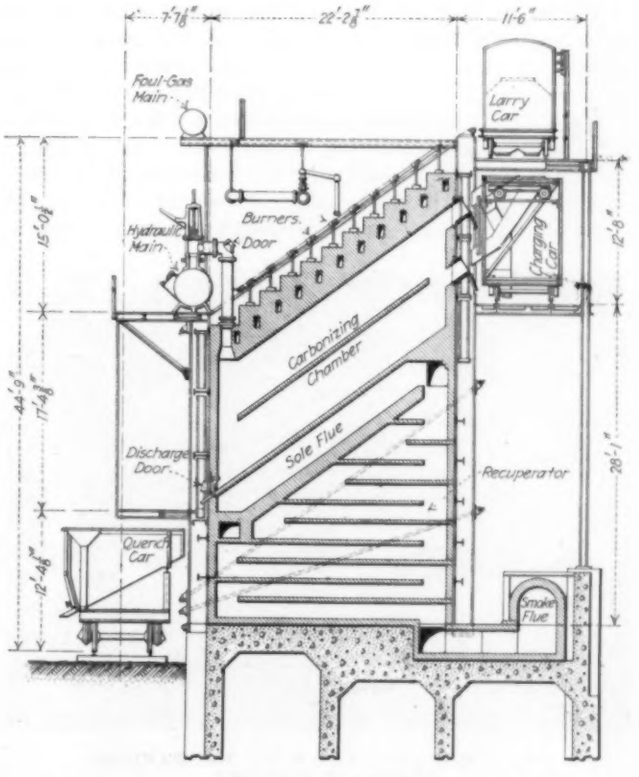


FIG. 3—CLINCHFIELD SECONDARY RETORTS

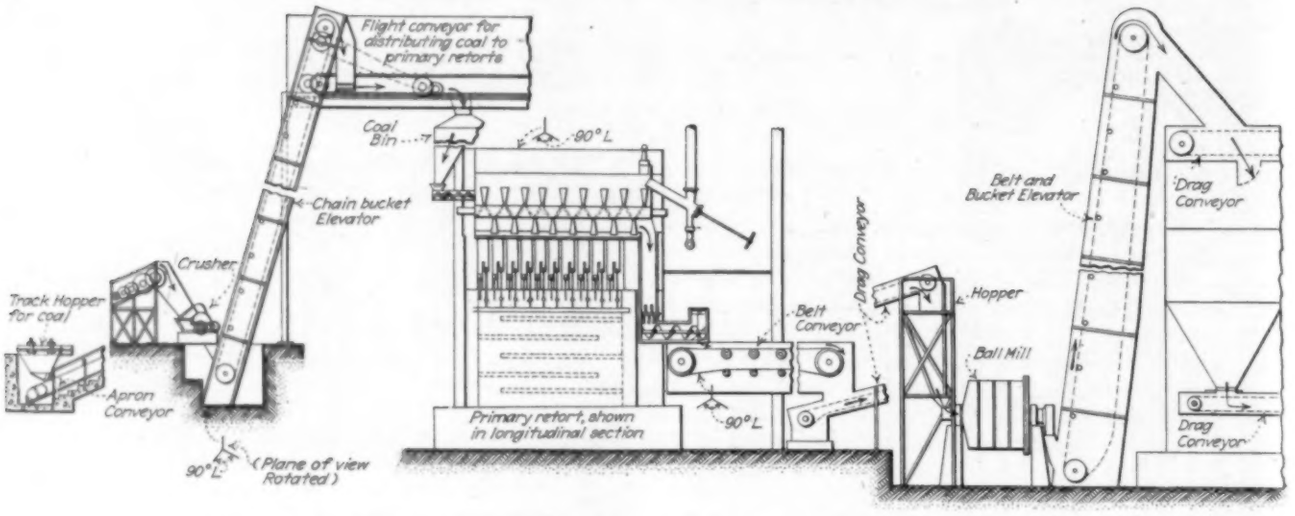
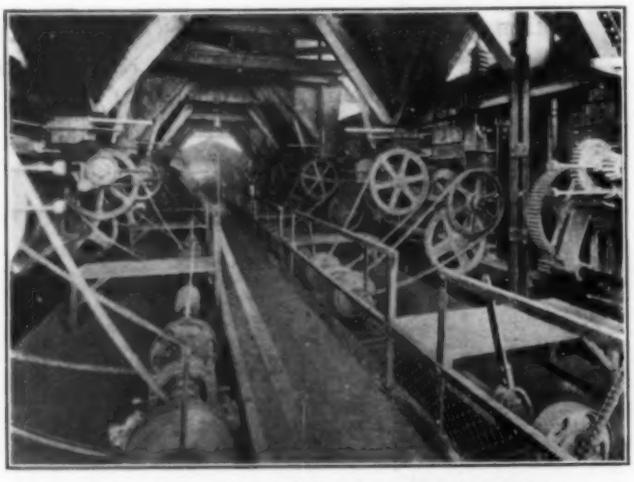


FIG. 4—EQUIPMENT FOR CARBOCOAL PRODUCTION. NOT DRAWN TO SCALE

laboratory, shop, storehouses, etc., as shown in Fig. 1. A pair of water gas generators are provided for starting the plant and to make up any deficit in gas supply.

Errors in Plant Design

In deciding upon equipment and layout for the Clinchfield plant there was apparently poor liaison between the officers of the company who approved the designs and the operating crew at the company's Irvington plant. While in general the Clinchfield plant was designed along the lines worked out at Irvington, there were numerous cases where Irvington experience was disregarded and equipment installed which had already been found inadequate. Certain parts of the plant are poorly arranged and there is evidence of poor engineering throughout the plant. It was, of course, inevitable that in a pioneer project of this sort mistakes would be made, but the Clinchfield plant certainly included more blunders than might reasonably be expected. This was most unfortunate, for the operating difficulties connected with a new process were certain to be numerous under the best of planning. As a matter of fact, the difficulties encountered at the Clinchfield plant were so numerous and so persistent that, although the plant was kept operating, the manufacturing costs bore no relation to the actual costs of carrying out the steps of the process, and after nearly 2 years of operation it finally appeared best to shut the plant down temporarily and solve some of the mechanical problems.



PADDLE DRIVES AND FEED MECHANISMS, PRIMARY RETORTS

In the pages which follow a number of operating difficulties are discussed and the method of overcoming some of them given. It should by no means be concluded that the whole Clinchfield plant was a failure mechanically, for such was not the case. The plant was operated and many thousands of tons of Carbocoal sent to market during 1920 and 1921. Commercial operation was deliberately discontinued in March, 1922, because persistent mechanical difficulties ran up the manufacturing costs above the market value of the products. Since March, 1922, an experimental program has been followed actively and solutions have been found for several of the most serious difficulties. It is only a question of solving minor mechanical problems now. The process itself is sound, the fuel produced readily salable, and the remaining mechanical problems are well defined.

Operation Difficulties

Carbon Deposit in Primary Retorts

Referring to Fig. 2, it is noted that there are necessarily small clearances between the ends of the paddles and the retort walls. Shortly after a retort is put into operation this space fills with carbon residue baked in place. At first this layer between the ends of the paddles and the retort wall is soft, but it gradually hardens until it passes the hardness of steel. The paddles then drag heavily over this hard surface, which ever tends to grow thicker until after, say, 50 or 60 or 70 days there comes a time when the resistance offered to the motion of the paddles is great enough to break the paddles, the paddle shafts or some part of the driving train.

At the time the Clinchfield plant was built it was known that this carbon deposit in the retort would give trouble, but it was thought that cleaning the retort once in 5 or 6 months would suffice. It was found in Clinchfield operation, however, that there was danger of breaking something after about 60 days. This was serious. In fact, this was perhaps the most serious problem which developed at Clinchfield. Persistent, foolishly persistent, attempts were made to keep retorts operating longer than 60 days, regardless of breakage, with results which were disastrous to the cost data at Clinchfield.

Numerous attempts had been made at Irvington and

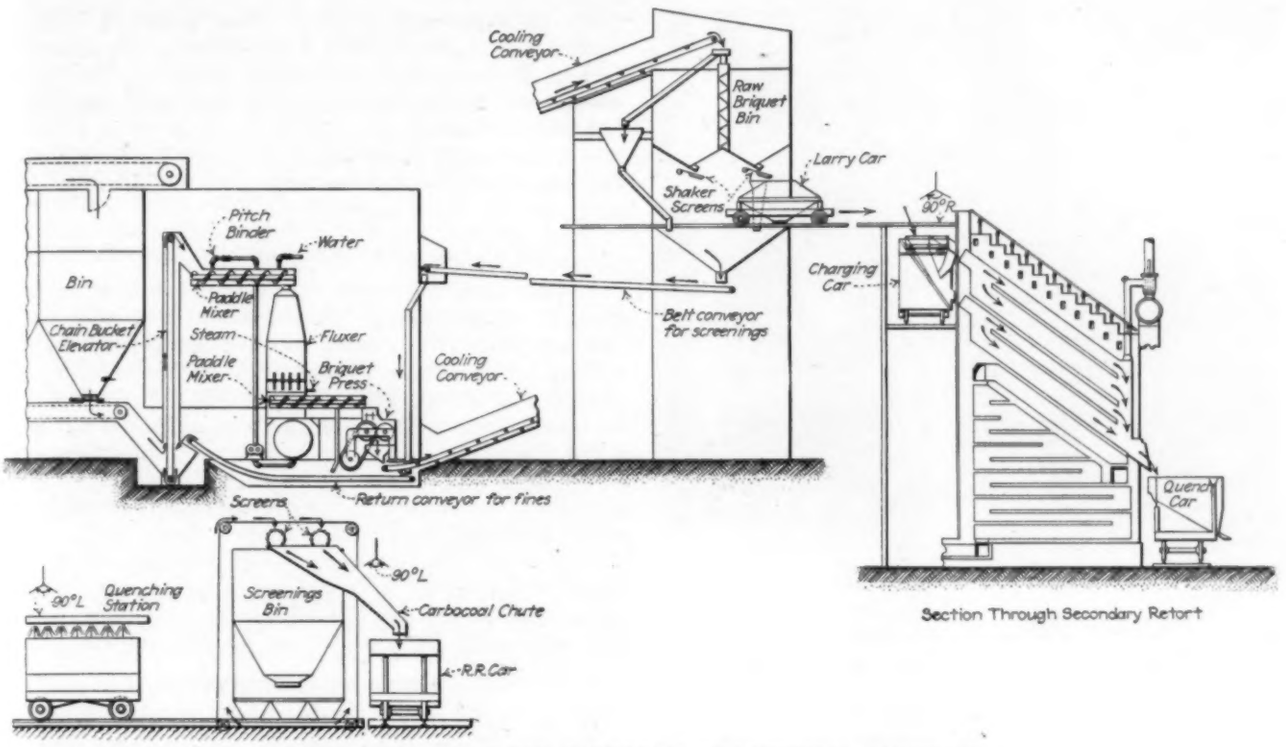
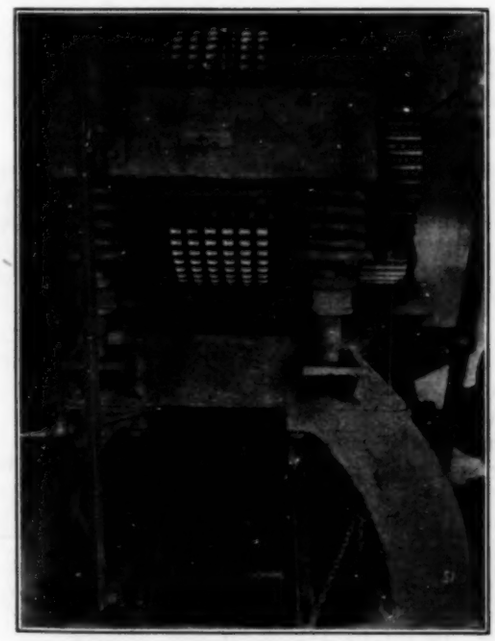


FIG. 4—EQUIPMENT FOR CARBOCOAL PRODUCTION (CONTINUED)

continued at Clinchfield to build paddies and paddle shafts strong enough to withstand the strain caused by the paddles scraping on the carbon deposit. Special steel tips of several sorts were tried on the paddles in the hope of getting something which would be hard enough to cut through the carbon deposit. All these attempts yielded nothing toward a solution of the problem. Late in 1921 a change in design of the paddle was worked out which made the paddle somewhat self-relieving—i.e., a slight bending of the paddle would act to relieve the extreme resistance at the tip. This, however, did not solve the problem. The idea was finally evolved of bolting light steel tips on the paddles and making these tips weak enough so that they would bend over and relieve the strain when the carbon deposit became very hard. This would save costly paddle and paddle shaft breakage at the expense of small steel tips, which could be replaced easily when the retort was shut down for cleaning.

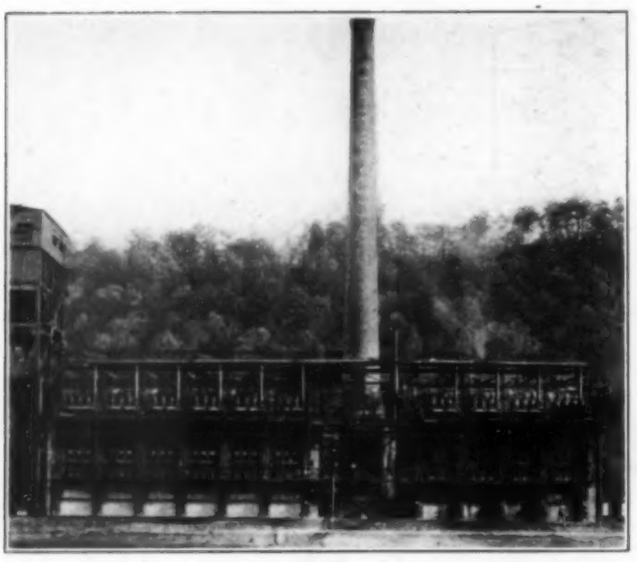


FRONT VIEW OF BRIQUET PRESS

Two independent tests were made with such paddles. At the end of 90 days' operation the retorts were still in good running condition. It is now planned to fit all retorts with this new type of paddle and to substitute removable cast-iorn tops for the carborundum arch in the upper half of the retort, so that the task of cleaning the carbon out of a retort will be an easier one and the time of shut-down reduced. A 3-day shut-down once in 90 days will not be serious if no repairs are necessary other than replacing the paddle tips. In a new plant it might be possible to design the retort so that the paddle shafts could be raised and lowered independently of the retort floor and so get around the danger of breaking paddles and shafts, but this cannot be done at Clinchfield.

Discharge Equipment on Primary Retorts

Mention has been made in an earlier paper of the difficulty encountered with the discharge arrangement for getting the carbon residue out of the retort. Referring to Fig. 2, it will be noted that the carbon residue first falls down a vertical chute about 7 ft. long. The hot gases in this chute create a stacking effect which must be overcome by carrying a gas pressure in the retort enough above atmospheric pressure to prevent air from coming in through the discharge, for the amount of "seal" secured in the "Vesuvius" discharge is actually quite small. If the pressure in the retort is too high, gas escapes through the discharge. The working limit is too narrow. In actual operation it was found necessary to operate with the discharge slightly below atmospheric pressure so as to avoid fires in the "Vesuvius." This meant a steady flow of air in through the hot carbon residue, making it still hotter and sending a stream



BATTERY OF SECONDARY RETORTS

of hot, carbon dioxide-bearing air into the retort. This carbon dioxide gave trouble later, of course, in the ammonia recovery equipment.

In addition to the above defect, the end-flights on the discharge screws and the driving gears on the discharge mechanism wore out rapidly due to the heavy work of pushing the carbon residue up over the dam in the "Vesuvius." Whenever the carbon residue was discharged in a plastic condition and whenever the end-flight had worn down to a certain point, the discharge would jam. It was then necessary to open relief discharge doors at the foot of the discharge chute while the hot screws were hauled out and the flights renewed.

Altogether, the discharge arrangement on the Clinchfield retort was thoroughly bad. A crew of mechanics was busy continually getting discharges back into operation, with consequent unnecessary increase in the operating costs.

Since the sealing of the retort accomplished by forcing the carbon residue up over the dam in the "Vesuvius" was so slight, it was eventually decided to cut a hole in the bottom of this casting and permit the carbon residue to fall directly from the discharge screws onto the conveyor belts. This relieved much of the load on the discharge drive mechanism and did not materially change the other conditions of operation. The discharges were in use this way at the time the plant was closed down in March, 1922. Since that time experiments with various discharge arrangements have been conducted. A successful discharge has been developed in which the carbon residue falls into an inclined cooling chamber at the end of the retort with a water-sealed door at the bottom of the chamber. From the cooling chambers to the ball mill the carbon residue will be moved in steel cars mounted on a track running around the batteries. Tests on this scheme are now in progress.

The Conveyor System for Carbon Residue

Belt conveyors were installed at Clinchfield for handling the carbon residue from the primary retorts to the ball mills. Experience has shown that the carbon residue coming from the retorts is too hot to be handled by rubber-covered conveyor belts. Replacements were required frequently, but the belts were continued in use.

As an experiment a short drag conveyor was installed just ahead of the ball mill hopper. The abrasive carbon residue caused excessive wear on the chain guides and the equipment would soon have been worn out if it had been continued in service. It is probable that a pan or an apron conveyor would be satisfactory. Our present scheme, however, is to use small hopper cars instead of a conveyor.

The Gas Offtake, Primary Retorts

In Clinchfield operation it was found difficult to keep the gas offtakes clean. As originally built each retort was provided with a hand-operated scraper in the gas offtake. The scraper would stick in the offtake frequently and its operation was irksome. For some time no scraper was used, the offtakes being poked out with a rod when they became so choked as to interfere with retort operation. Later, however, the scrapers were replaced and an electric motor for driving them mounted on an overhead track. This made a fairly satisfactory arrangement. During some recent experiments it was found that a certain arrangement of liquor sprays eliminated most of the gas offtake trouble, and these sprays will eventually be installed on all the retorts.

Grinding Equipment

It has been found at Irvington that the Williams hammer mill was unsuited for grinding material as abrasive as carbon residue. Completely disregarding this experience, two such hammer mills were installed at Clinchfield. As a result, the screen analysis on the ground carbon residue was seldom correct for getting best results, and this accounted in part for the poor quality of the Carbocoal made at first. Five months after the plant was started, a Kennedy-Van Saun ball mill was installed and during the summer of 1921 a Marcy ball mill was added. Either one of these mills will grind the total carbon residue output of the primary retorts, say 18 tons per hour. The Marcy mill is much the superior of the two mills.

While the ball mills grind the carbon residue satisfactorily and stand up well under constant use, we feel that the grinding problem is not entirely solved. The ball mills in use now require 200- to 250-hp. drive motors. The power cost for grinding seems too high. It is possible that much smaller rod mills would do the work satisfactorily, and this experiment is on our schedule.

The Briquet Presses

The briquet presses installed at Clinchfield are roll presses with flat-link chains running between briquet dies so as to give briquets with flat ends. These presses are exceptionally well built, but, unfortunately, the wear on the chains with a material as abrasive as carbon residue is excessive, even though the chains be made of glass-hard alloy steel. When the chains wear thin, they do not fill their grooves on the rolls and briquet material is forced into these grooves, preventing the briquets from slipping in the dies as they pass beyond the point of maximum pressure. This gives briquets with one rough side and increases the percentage of fines beyond the presses. It is likely that some type of Belgian press without the chains will be installed before operations are resumed at Clinchfield.

Handling of Raw Briquets

It was known at Irvington that the raw briquets should be handled gently and that it was bad practice

to put raw briquets into a large bin and draw them out at the foot of the bin. The briquets rub over one another too severely as the mass settles down to the discharge door. One of the most important things in handling a raw briquet which is to be carbonized later is to keep the shiny surface. A rough briquet will yield rough Carbocoal which does not stand shipment nearly so well as does smooth Carbocoal.

At Clinchfield the briquet-handling equipment is very poorly arranged. The long cooling conveyor following the briquet presses carry the briquets over 90 ft. into the air, from which height they must roll and fall and bump in various steps down into the retorts and eventually to ground level. This part of the Clinchfield plant will have to be rebuilt along better lines.

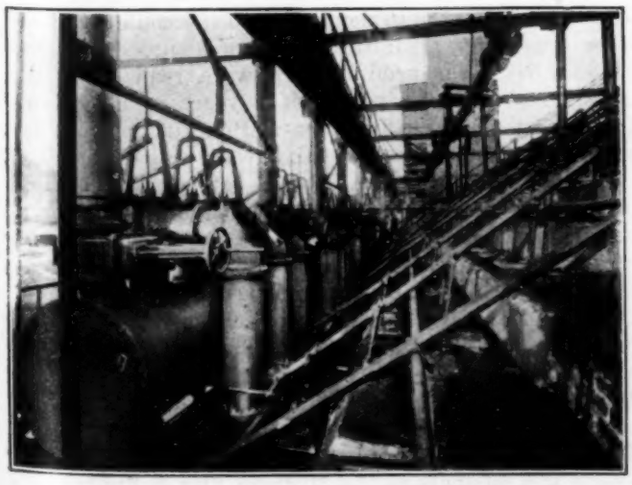
Secondary Retorts

The secondary retorts at Clinchfield did not do as well as Irvington experience had predicted, and the experience with them at Irvington was none too promising. When the conditions surrounding the manufacture of the raw briquets have been very good, speaking in terms of the factors mentioned in the first paper of this series, then the secondary retorts will operate well. Let the quality of the briquets be a little below the highest, however, and the secondary retorts yield a poor product.

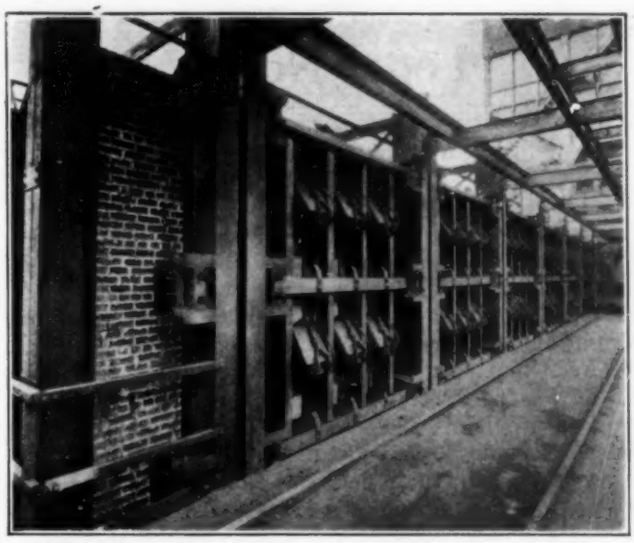
The heating system on the secondary retorts is poor and the top chambers are invariably too hot and the lower chambers too cold for good results. Iron burner pipes were first installed at the top of the heating flues. These would soon burn off. Carborundum burner blocks were next installed. These plugged with carbon from the cracked gases and many of them were broken in cleaning. Chromel alloy tubes would stand the temperature at the top of the flues, but were expensive. Eventually a fairly satisfactory solution of the burner problem was found by running the gas into the combustion flue through a hole drilled in a fireclay block at the top of the flue.

The worst trouble with the secondary retorts, however, was that the briquets would hang up in the chambers and it required much poking with long rods to get them out. Meanwhile, the briquets which had already rolled out were lying in the quench car burning rapidly.

Designs for better secondary retorts are now being made at Clinchfield and the first unit of these will soon be set up and tested. If it proves satisfactory, then the last of the main operating difficulties which caused a decision to close the plant temporarily will have been cleared away and operation of the plant can be resumed after the necessary changes have been made and the new units added.



TOP VIEW OF SECONDARY RETORTS



CHARGING PLATFORM, SECONDARY RETORTS

Conclusion

In the foregoing pages we have given prominence to numerous operating difficulties which arose in the Clinchfield plant. It must be borne in mind that in spite of these the plant was operated and the products marketed, and the plant could have been kept in operation indefinitely. Of the mechanical difficulties which kept manufacturing costs too high, several have been solved since the shut-down last March. A satisfactory method of carbonizing briquets is, we believe, about the only serious problem which now stands in the way of successful operation at Clinchfield.

Determination of Gas in Metal

It has been found, by recent work at the Bureau of Standards, that the most satisfactory method of heating the metal samples for the extraction of gases under vacuum is by the use of a high-frequency induction furnace. This method of heating has eliminated many of the difficulties and sources of errors common to previous methods of vacuum fusion. The analyses of the evolved gases for oxygen and hydrogen are carried out gravimetrically by the use of a train of solid absorbents which satisfactorily absorbs the gases even at comparatively low pressures as rapidly as they are pumped out of the furnace. A modified form of absorption tube has been developed which is connected in the all-glass train by means of ground glass joints so that it can readily be removed for weighing.

Three methods of fusing the metal samples have been investigated—namely, direct fusion in a refractory oxide crucible; fusion with antimony-tin alloy in an oxide or silicate crucible; and fusion in a gas-free graphite crucible. The antimony-tin method was originally developed by Goerens and is usually so named, while fusion in graphite is a method previously attempted by Walker and Patrick. Each of these three methods of fusion has been tried using both carbon-free and carbon-bearing metal. The usual refractories were found to be entirely unsuitable for use in the direct fusion of carbon-bearing metals without any alloying addition.

Legal Notes

By Wellington Gustin

Perkins Patent for Process and Product Covering Glue Upheld in Three Cases

The Perkins reissue patent, No. 13,434, for a wood glue and process of making same was held valid and infringed in the cases of Perkins Glue Co. vs. Hood & Wright and same vs. the West Michigan Furniture Co., 279 Fed. Rep., 454, decided by District Judge Sessions.

Suit was brought in each case for infringement of two process claims, Nos. 13 and 38, and three product claims, Nos. 28, 30 and 31, of the patent. The patent covers a vegetable glue derived from starch or starchy products, having the adhesive strength and qualities of animal glue and suitable for gluing woods, especially veneers; and also the method or process of making such glue.

Glue Base Purchased and Treated by Method of Patent

The defendants used the glue mainly for making veneers. Each bought the prepared glue base from the National Process Co., then subjected the glue base so purchased to the treatment of the final process described in the patent, and thus produces the glue of the patent ready for use.

The glue base manufactured and sold by the National and International Process companies of Indianapolis and used by the defendants is not prepared in accordance with the method or first step of the process of the patent, but is produced by mixing commercial starches of different grades and kinds, the raw, underdegenerated and overdegenerated starches being so proportioned that the mixture has the same average degeneration and the same water absorptive properties as the processed glue base of the patent.

Claims for Final Process and Resultant Product Valid

The court found the claims of the patent for the glue base as well as the process of preparing it to be invalid, but same were not involved in this action. But it did find that the claims for the finished product and for the complete process of preparing such product were valid; also it found that the claims for the glue resulting from the application of the final process to the glue base of the patent are valid, notwithstanding the fact that neither the glue base itself nor the process of making it is patentable.

For the glue base may be produced, it was admitted, without using the inventor's preferred process. And it follows, said the court, that the claims for the inventor's final process, applied to or in combination with the glue base of the patent, in whatever manner such base may have been produced, are valid. A patentable product does not result from the practice of an old, well-known and non-patentable process. The Court of Appeals had, in a former case, held the claims valid for the final process and the resultant product. Clearly, it says here, "final" process does not necessarily or presumably mean "complete" process and the patent claims were "not strictly for the second step of the process above and as such, but are for the final process, applied to or in combination with the glue base of the patent."

Now the owner of a patent is bound by the disclaimer in the patent. The sole object of the disclaimer in the patent at bar was to narrow the claims with respect to the starchy product or glue base to be subjected to the final process of the patent. Under the disclaimer the starch or starchy product to be processed must be degenerated to the extent described in the patent before being subjected to the final process of the patent. So limited, the claims are valid and infringed, said the court.

Case Where Single Starch Was Used for Base

This same court was called to pass upon the patent again in an action brought against the Holland Furniture Co. and others.

The only substantial difference between the former cases and this one was found in the method of producing a part of the base used by the defendants in the production of the glue. In this case a part of the glue base was produced by another manufacturer by selecting a single grade and quality of commercial cassava starch and merely sifting out the impurities therein contained. Manifestly the resultant glue base is the same, whether consisting of a mixture of starches of different degrees of degeneration or of a single starch of the same degree of degeneration as the mixture. Defendant's final product was obtained by subjecting the glue base to the treatment described in the patent as the second or final step of the patented process, and was identical with the glue of the patent; and the court held it did so combine product and process in the preparation of its glue as to infringe the product claims of the patent.

Standard of Comparison for Determining Profit From Infringement of Alkaline Process for Reclaiming Rubber

The standard of comparison for determining profits earned by an infringement is a point involved in a suit brought by the Philadelphia Rubber Works against the United States Rubber Reclaiming Works and others. There it was held by the Circuit Court of Appeals of the United States that a process developed by an infringer after an injunction against infringement was issued to avoid the infringement, cannot be adopted as a standard of comparison in determining the profits due to the infringement. (277 Federal, 171.)

The case was before the Court of Appeals from a decree by the District Court fixing the amount of damages for the infringement after an accounting, both sides appealing. Plaintiff had been awarded the sum of $324,597.46 as profits which were realized by the defendants during a period of 5 years of alleged infringement of plaintiff's patent. Plaintiff appealed for the reason that it contended the award was too small.

The suit involves the Marks patent, No. 635,141, owned by the plaintiff, Philadelphia Rubber Works, covering a process for devulcanizing rubber waste. The patent was held valid and infringed in the District Court, and this result was affirmed on appeal. (143 C. C. A., 426.) There the court decided that the Marks patent accomplished a new result by the application of a new process to the reclamation of rubber waste. Defendant, United States Rubber Reclaiming Works, conveyed its business and property to the United States Rubber Reclaiming Co., Inc., which later transferred its assets and business to the Madison Tire & Rubber Co., each of which were made parties defendants in this suit.

The District Court ruled that there was no standard of comparison from which to estimate the profits, and that the plaintiff was entitled to recover the entire profits made by the defendants from reclaimed rubber produced by the infringing process. It refused to allow a deduction of $179,309.24 for alleged profits on the compounds which the defendants claim that they incorporated into the reclaimed rubber sold. It further refused to allow the defendants a reduction of $75,946.24 for alleged profits made from operations subsequent to the devulcanizing process, which operations are usual and customary in reclaiming rubber to put the product in condition for sale. To the sum agreed upon by the accountants as the basic figure of profits, $610,581.66, the court added $10,982.48, a portion of $21,507.30 which was deducted in fixing said sum as special expenses, a proportion of the sum of $21,004.18 legal expenses, and a proportion of the reorganization expenses of defendants of $3,461.71. The court held this to have been improperly charged to the cost of the operation with the infringing process.

District Court Allowed Recovery of Entire Profits

Further, the District Court reduced the profits by $122,932.57, apportioning certain expenses between the infringing and non-infringing processes—that is, it divided the general expenses equally between the defendants' two mills and allowed this as a deduction. The plaintiff claims that the court should have followed the method adopted by the accountants jointly representing the parties. Then the court allowed a reduction of $197,200.72 for interest on capital invested in the plant and business using the infringing process. Defendants claimed the court erred in making the Madison Tire & Rubber Co. a party and requiring payment of the damages by it.

Marks Process

The process of the Marks patent for devulcanizing rubber waste consists in submerging the finely ground rubber waste in a dilute alkaline solution in a sealed vessel, and in keeping the contents of the vessel at a temperature of 344 deg. F., and in maintaining this temperature for 20 hours, more or less. The court held that the defendants appropriated the essential elements of this process and thereby achieved the same result as the Marks patent accomplishes. The questions of validity and infringement were established against the defendants by the previous decision of the court cited above.

The Marks process opened a new field for production of reclaimed rubber—that being from highly vulcanized scrap. This had never previously been successfully accomplished. By the acid process, the court found, rubber had been reclaimed from boots and shoes and made capable of being used for other purposes. But from the reception and use of the Marks process in the trade and the results accomplished by it, the court found this process was of great monetary and economic value, particularly in reclaiming rubber used in automobile tires.

Alkaline Process Only One Successful With Tire Scrap

It is pointed out that the devulcanized rubber must not only possess a maximum plasticity and absorptive ability but must not lose these properties with age, and the revulcanized reclaimed rubber must show high tensile strength and high elongation, and must retain these properties for a maximum period of time. Tire scrap devulcanized by the acid process does not exhibit these properties, which are observed in the stock devulcanized by the alkali process. And also because of its increased plasticity prior to vulcanization, the alkali stock exhibits a superior abrasive resistance, and is superior as to aging. Such that proof showed that the Marks patent was one of the most successful and valuable rubber patents ever issued.

It was found that the defendants' product essentially derived its marketability and value from the unlawful appropriation of the process of Marks. Therefore the court awarded the plaintiff, owner of the Marks patent, the entire profits made by defendants from the sale of reclaimed rubber produced by the Marks process.

The Court of Appeals held that the rule of damages applied by the court below was correct, and that there was no process in use or known which could be used as a standard of comparison as contended for by the defendants. Again, it says that in determining the profits of an infringer, other methods of accomplishing the results of the patented process cannot be used as standards of comparison, if such methods were covered by other patents so as not to be available to the infringer.

No Other Method Available for Defendants

In such cases, the court says, in finding the proper amount of damages the question to be determined is, What advantage did the defendant derive from using the plaintiff's invention over what he had in using other processes then open to the public and adequate to obtain an equally beneficial result? The fruits of that advantage are the profits, and these are the damages to the owner of the invention.

The standard of comparison for determining the profits earned by an infringement, to be applicable in the case, must have been known and open prior to the date of the plaintiff's patent. The field of selection of process which might be used should be, in principle, that which is open to the art at the time the invention is appropriated. Where there is a patent which forbids such use, the question is presented whether it is actually available to the infringer during the period of infringement. Where the owner of the patent declines to permit its use or grant a license, it cannot be set up as a standard of comparison, says the court.

Neither may processes which were developed after the infringement as a substitute for use by the defendants be used as a standard of comparison. In this case the court found no process which might be used as this standard. Therefore the rule applicable required the defendants to pay over to the plaintiff all the profits which they derived through unlawful infringement.

Now, where profits are made by the use of an article patented as an entirety, the infringer is liable for all the profits, unless he can show, and the burden is on him to show, that a portion of them is the result of some other things used.

Claim of Profit on Other Steps Not Allowed

The defendants argued that a small portion only of the total profits is due to the devulcanizing step and that the remainder is due to the finishing and refining steps performed subsequently. The devulcanized rubber is not immediately in condition for sale or use, but is subjected to the refining and finishing steps. Defendants argued that of the total cost of producing

reclaimed rubber, only 18 per cent of that cost is incurred in the devulcanizing step, the balance being due to subsequent steps. But the evidence showed that the value of the product is due to the devulcanizing process, the reclaimed rubber being given characteristics wholly different from the characteristics of acid reclaimed tire scrap. These characteristics result in a new product, which could be attained only by depolymerizing the waste or breaking down the rubber molecules formed during vulcanization. The particular rubber product obtained could be obtained only by the Marks process. The fact is, says the court, that defendants could not have sold the reclaimed rubber without first having imparted to that rubber the characteristics resulting from the Marks process. This cannot be separated from the finishing and refining which help to make the article marketable. The court found it impossible for the defendants, without the wrongful use of plaintiff's process, to carry on their operations as they did. It appeared that the entire commercial value of the rubber arises from the use of the patented process and the court said plaintiff was entitled to recover from the infringer the total profits derived.

Infringer Could Not Claim That Part of Profits Was Made on Compounds

Further, the defendants contended for alleged profits on compounds which were incorporated in the reclaimed rubber sold. There were about 7 per cent of various compounding ingredients used, costing defendants $57,157.72, and they claimed the right to deduct the profits which they claim to have made in these ingredients, or a total sum of $179,309.24. The court found no proof that these compounds, after being combined with the rubber, were of any greater value than when put in. But since the whole product was sold at the market price for rubber, the infringer could not claim that a portion of his profits was a profit on the compounds used, and he is entitled to deduct only the cost of the compounds according to the ruling of the court.

Again, in determining the profits earned by an infringer, special payments made by the infringer to its officers, in addition to their regular salaries, legal expenses incurred in defending the infringement suit and expenses of reorganizing the infringing corporation cannot be deducted from the gross profits. Yet interest on the capital invested in the infringing portion of defendant's business was properly allowed as a charge against the gross profits from the infringing product.

In its findings the court says this was not a willful and deliberate infringement. The District Court was upheld in its holdings by the appellate court, and the United States Supreme Court, after a hearing on a petition for a certiorari to bring it up to that court, denied the petition.

A Slide Rule for Oil Viscosities

For more than 30 years the oil industry has employed various viscosimeters, there being in common use four types—the Saybolt in the United States, the Redwood in England and the colonies, the Engler in Germany and most other countries, including France, where also the Barbey ixometer is used by the French Government.

Unfortunately all attempts to introduce or adopt one type of instrument to be used universally have failed. The scientific method for determining viscosities of oil in absolute measure as poise has not reached the stage to be adopted by the oil industry.

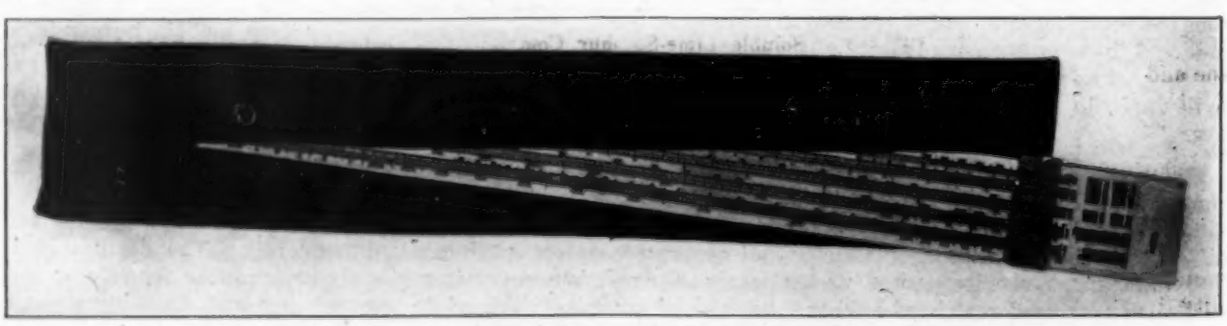
Almost every refinery and plant doing business in foreign countries is handicapped by the requirement of tests on the different instruments as before noted. This means that the actual tests must be made on the various instruments or use made of various calculated tables and plotted curves for the approximate conversion of the viscosity from one instrument to another, which is time consuming and not always accurate.

An attempt to provide the oil industry with an instrument for converting the viscosity of an oil from the value of one instrument to the value of another instrument at the same temperature, as well as at slightly different temperatures, has resulted in the designing of an instrument known as the "Visconvertor" by V. L. Chechot of the physical testing staff of the Atlantic Refining Co. of Philadelphia. Results obtained on this instrument are accurate within a reasonable degree, slight variations being expected in converting from one temperature to another according to the crude source.

The corresponding viscosities are arranged in logarithmical lines, similar to a slide rule, and the reading is made in simple manner by placing a slider over the observed instrument line and reading the corresponding value on the desired instrument line.

The arrangement of the logarithmical lines is such that it is possible to convert viscosities at the same temperature on the four instruments mentioned—viz., Saybolt, Redwood, Engler and Barbey. Also Saybolt at 100 deg. F. can be translated into Engler at 50 deg. C. or Barbey at 50 deg. C.; Saybolt at 100 deg. F. to Redwood at 140 deg. F. or Saybolt at 130 deg. F.; Saybolt at 130 deg. F. to Redwood at 140 deg. F.; Engler at 50 deg. C. to Engler at 20 deg. C. or Barbey at 50 deg. C.; Saybolt at 210 deg. F. to Engler or Barbey; Redwood at 200 deg. F. to Saybolt at 210 deg. F., etc.

The data used in preparing this instrument have been calculated theoretically by means of absolute and kinematic viscosities and then verified by actual tests on certified instruments. The reverse side of the rule contains a considerable amount of data and formulas pertaining to the oil industry.



THE VISCONVERTOR, A SLIDE RULE FOR CONVERTING V ISCOSITY READINGS

Synopsis of Recent Chemical & Metallurgical Literature

A Possible Revolution in the Rubber Industry

An article in the January 1 issue of *India Rubber World* reports some new developments which have been carried out, largely by the U. S. Rubber Company, in the use of rubber latex. Latex is actually the raw material from which rubber is made. It is the sap of the rubber tree and crude rubber was originally made from this by dipping a paddle in the latex and holding the paddle with the adhering layer over the smoke of a peculiar kind of nut which gave off astringent fumes. The paddle was repeatedly dipped into the latex and then held over the fire so that a mass of coagulated rubber was built up on it in layer formation. On the plantations latex is coagulated by means of acetic acid or other chemicals.

The new development has to do with the use of latex as such in factories and thus simplifies, first, the labor on the plantation and second, the transportation. If the liquid latex can be shipped, then it would be very much easier to handle it in tank cars and tank steamers and again in tank cars than it would be to handle the rubber in whatever form it was finally produced as for example smoked sheets. One of the problems confronting the producers of rubber was to prevent the latex from coagulating and this has been done most satisfactorily by the addition of ammonia. At the present time there are actually tank steamers running between the plantations and the United States ports carrying cargo loads of latex.

Drying Latex

The new developments were, of course, inevitable when the latex was worked upon a large scale in modern factories. In the first place a better grade of rubber has been produced by what is known as the spray process. The process was worked out by Mr. Hopkinson of the United States Rubber Company. It consists in running a stream of latex onto a rapidly revolving wheel in a heated chamber. The latex is thrown off in a highly atomized form and the finely divided particles are dried by incoming hot gases without raising the temperature to a point which would be detrimental to the rubber. The small particles fall like snowflakes onto conveying apparatus which delivers the rubber outside the chamber. The heat is produced by means of an oil burning furnace used in conjunction with additional inlets for air. This rubber gives a very substantial increase in tensile strength and resistance to abrasion over crude rubber prepared on the plantations. An additional advantage lies in the fact that the vulcanizing and compounding ingredients may be introduced into the mixture by spraying them in with the latex, rather than by working them up in the mills to good advantage.

Recent Chemical & Metallurgical Patents

American Patents Issued Jan. 2, 1923

The following numbers have been selected from the latest available issue of the *Official Gazette* of the United States Patent Office because they appear to have pertinent interest for *Chem. & Met.* readers. They will be studied later by *Chem. & Met.'s* staff and those which, in our judgment, are most worthy will be published in abstract. It is recognized that we cannot always anticipate our readers' interests and accordingly this advance list is published for the benefit of those who may not care to await our judgment and synopsis.

1,440,371—Process and Apparatus for Treating Rubber. G. B. Britton; assigned to Firestone Tire & Rubber Co., Akron, Ohio.

1,440,448—Varnish Film for Insulating Purposes. P. E. Demmler, Pittsburgh, Pa.; assigned to Westinghouse Electric & Manufacturing Co.

1,440,455—Vulcanizable Composition. W. E. Gardner, Pittsburgh, Pa.

1,440,501—Process for Dyeing Cellulose Acetate. E. P. Sisley, Lyon, France; assigned to Société Chimiques des Usines du Rhone.

1,440,502—Method of Making Fine Metallic Powders and Colloidal Solution. J. Slepian, Wilkinsburg, Pa.; assigned to Westinghouse Electric and Manufacturing Co.

1,440,515—Melting Furnace. H. G. Wellman and C. D. Gilpin, Cleveland, Ohio.

1,440,533—Apparatus for Roasting Ores. C. G. Fink, Yonkers, N. Y.; assigned to Guggenheim Bros.

1,440,540—Method and Apparatus for Heat-Treatment. W. J. Harris, Jr., New York; assigned to Surface Combustion Co.

1,440,548—Apparatus for Evaporating or Treating Substances Containing Liquids. H. S. Mellott, Morenci, Mich.; assigned to By-Products Recovery Co., Toledo, Ohio.

1,440,566—Manufacture of Chromed Dyestuffs. F. Straub, Basel, Switzerland; assigned to Society of Chemical Industry in Basel, Switzerland.

1,440,621—Manufacture of Mono and Bi Para Monoalkyl Aminophenylarsinic Acids. C. J. Oechslin, Ablon, France.

1,440,652—Normal Butyl Esters of Para-amino Benzoic Acid. Roger Adams, Urbana, and E. H. Volwiler, Chicago, Ill.; assigned to Abbott Laboratories, Chicago, Ill.

1,440,683—Production of Normal Propyl Chloride. C. O. Johns and Hyym E. Buc, Roselle, N. J.; assigned to Standard Development Co., New York.

1,440,723—Evaporator. C. W. Dyson, U. S. Navy, and McStuart, Annapolis, Md.; assisgned to Andale Engineering Co., Philadelphia.

1,440,724—Electrode for Electric Furnaces. C. W. Soderberg, Christiania, Norway; assigned to Det Norske Aktieselskab for Elektrokemisk Industri, Norway.

1,440,767—Explosive. R. M. Cook, Tamaqua, Pa.; assigned to Atlas Powder Co.

1,440,768—Explosive. R. M. Cook, Tamaqua, Pa.; assigned to Atlas Powder Co.

1,440,772—Apparatus for Treating Petroleum. C. P. Dubbs, Wilmette, Ill.; assigned to Universal Oil Products Co., Chicago.

1,440,774—Electrical Dehydrator. W. O. Eddy, Los Angeles, Calif.; assigned to Petroleum Rectifying Co. of California.

1,440,775—Dehydrator same as 1,440,774.

1,440,776—Dehydrator same as 1,440,774.

1,440,813—Iodine Compound. Rezso Benko, Budapest, Hungary.

1,440,828—Dehydrator. F. W. Harris, Los Angeles, Calif.; assigned to Petroleum Rectifying Co. of California.

1,440,833—Yellow Vat Dye. George Kalischer, Frankfort, Germany; assigned to Leopold Cassella & Co.

1,440,835—Apparatus for Dehydrating Petroleum. N. Meredith, Alameda, Calif.; assigned to Petroleum Rectifying Co.

1,440,836—Commercial Fertilizer. E. A. Morgan, Dorchester, Mass.

1,440,848-849-850—Process for Making Sodium Compounds of Dioxydiamino arsenobenzene. U. Suzuki, Tokyo, Japan.

1,440,961-2-3-4—Process of Vulcanizing Rubber and Products. S. M. Cadwell, New York; assigned to Naugatuck Chemical Co., Connecticut.

1,440,973—Controlling Foaming of Boiling Liquids. C. E. Dolbear, San Francisco, Calif.; assigned to Industrial Research Co., San Francisco.

1,440,976—Process of Making Chlorinated Bodies. C. Ellis and A. A. Wells, Montclair, N. J.; assigned to S. B. Hunt, trustee.

1,440,996—Treating Heavy Hydrocarbons. U. S. Jenkins and S. Schwartz, Arkansas City, Kan.

1,441,063—Treating Sulphide Ores. N. C. Christensen, Salt Lake City.

1,441,064—Treating Lead Ores. N. C. Christensen, Salt Lake City.

1,491,065—Treating Oxidized Lead Ores. N. C. Christensen, Salt Lake City.

1,441,072—Treating Lead-Zinc Ore. F. E. Elmore, Boxmoor, England.

1,441,143—Cellulose-Ether Solvent. S. J. Carroll, Rochester, N. Y.; assigned to Eastman Kodak Co.

1,441,181—Cellulose-Ether Composition. S. E. Sheppard, Rochester, N. Y.; assigned to Eastman Kodak Co.

Complete specifications of any United States patent may be obtained by remitting 10c. to the Commissioner of Patents, Washington, D. C.

Soluble Lime-Sulphur Composition—E. H. French, J. R. Withrow and A. O. Allen have assigned the Glidden Company of Cleveland the following patent for soluble lime-sulphur composition. The trouble in the past has been that when lime-sulphur is evaporated to dryness or to concentrated solution, in order to handle it with more facility, a certain amount of decomposition takes place and the lime-sulphur is no longer soluble in water. This presents difficult field problems. To overcome this difficulty the authors have first mixed calcium hydrate and sulphur in the molecular proportions of 3 slaked lime to 12 of sulphur. To this they have added water enough to bring the resultant solution to a density of 32 to 35 Baumé after the reaction has been completed. Then before exaporating the dryness 5 per cent of albuminous substance is added, such as glue, gelatine, etc. In some way this material combines with calcium polysulphide and keeps it soluble after evaporation has taken place to the desired concentration. (1,437,838. Dec. 5, 1922.)

Cellulose Acetate Solvent—The use of cyclobutanone as solvent for cellulose acetates in the manufacture of varnishes, artificial silk and films is covered by a patent granted to Henry Dreyfus. It is claimed that cyclobutanone is an excellent solvent for cellulose acetate, better than cyclohexanone. The cyclobutanone or side chain homologues thereof may be used in any desired quantity relative to the cellulose acetate either alone or with suitable diluents or solvents, such as methyl alcohol, acetone, etc. Any other usual or suitable substances such as camphor, fillers, coloring matter, etc., may be added in making the various products. (1,440,006. Henry Dreyfus, London, England. Dec. 26, 1922.)

Ammonia as Nitrocellulose Solvent—A patent recently issued to John Collins Clancy covers the use of liquid anhydrous ammonia as a solvent for nitrocellulose. Anhydrous ammonia is said to serve as an excellent solvent for the nitrates of cellulose generally, being capable of readily dissolving the higher nitrates which have heretofore been regarded as insoluble or soluble only in a very limited number of solvents. It is also claimed that the higher nitrates, as well as the more readily soluble lower nitrates, can be dissolved in liquid anhydrous ammonia without losing their structural aggregates.

Not only is it possible to dissolve the nitrates of cellulose in liquid anhydrous ammonia, but solutions thus formed may be transferred into other suitable menstrua and upon exaporating off the ammonia the nitrates will remain in solution in the menstrua to which they have been transferred, even though the nitrates were not initially soluble in such menstrua.

It is claimed that the same result may be accomplished by simply moistening the cellulose nitrates with liquid anhydrous ammonia, thereby changing the nitrates to a gelatinous mass, even when the ammonia is not added in sufficient quantity to form a clear solution. The cellulose nitrates thus treated when transferred to the tetrachlorethane, carbon tetrachloride, benzene, alcohol or ester, which is to constitute the final solution medium, will immediately form a clear transparent solution of any degree of viscosity desired, and when the process is carried out by this method the use of pressure may be dispensed with, as a sufficient quantity of ammonia will remain in the cellulose nitrates during the transfer to the solvent, even at atmospheric pressure, to render the nitrates soluble in the second solvent.

The advantages of such a process are pointed out in the specifications. Obviously, this extra step in the solution of nitrates of cellulose will allow a wider latitude in the choice of solvent for a nitrocellulose solution of any desired characteristics. It also would permit the use of non-flammable solvents which cannot be used ordinarily on account of their low solvent value. (1,439,293. John Collins Clancy, Providence, R. I.; assignor to the Nitrogen Corp. of Providence. Dec. 19, 1922.)

Cellulose Nitrate — The cellulose nitrate used in the manufacture of pyroxylin plastics is usually made by nitrating shredded tissue paper. It is a well known fact that during the nitration process there is a considerable amount of acid lost by chemical combination with the cellulose and by the formation of acid fumes and by the mechanical retention of acid in the nitrated fiber. R. P. Calvert has been granted a patent which is assigned to E. I. du Pont de Nemours & Co., Wilmington, Del., covering the process of compressing the paper before it is nitrated by passing it through calenders under a pressure sufficient to materially reduce its thickness. The results of experiments made to compare the acid loss on paper which was nitrated without previous compression with that which had been subjected to the extra step showed a net saving of about 0.4 of a pound of concentrated acid for each pound of nitrocellulose produced. (1,437,041. Robert P. Calvert, assignor to E. I. du Pont de Nemours & Co. Nov. 28, 1922.)

Reclaiming Nitrocellulose From Pyro Smokeless Powder—At the end of the war there existed large surplus stocks of pyro smokeless powder, originally containing about 0.5 per cent of diphenylamine. Some of this powder is not suitable for use in the arts because the powder grains are difficultly soluble in the usual pyroxylin solvents on account of their relatively large size and also because a solution of pyro has a viscosity which is too high for use in coating fabrics, etc. As is well known the decomposition products of the powder form dark colored nitroso and nitro derivatives, which react with the diphenylamine and make the powder solutions unsuitable for use except in very dark colored products. It has also been found that the presence of diphenylamine in a solution of pyroxylin causes a rapid falling in the viscosity of the solution on standing, just as a number of inorganic salts are known to do. This also militates against the use of pyro powder as a substitute for pure pyroxylin in its various applications.

A patent has been granted to Richard G. Woodbridge, assignor to E. I. du Pont de Nemours & Co., of Wilmington, Del., covering a process for the extraction of diphenylamine from pyro powder. The process comprises immersing the powder grains in a liquid which is substantially a non-solvent for the powder, such as propyl alcohol, butyl alcohol or benzene and heating the mass at a temperature near the boiling point of the solvent. It is preferable to use a liquid which is a non-solvent for the powder, but which, at a boiling temperature, is a good solvent for diphenylamine and is also a solvent for the nitroso and nitro derivatives of diphenylamine.

It is claimed that by such a treatment the viscosity of the powder solution is reduced to a point where it can be conveniently handled and that the diphenylamine content is reduced to a point where its influence is negligible. In an example of the process the patentee describes an experiment in which a sample of powder originally containing 0.45 per cent of diphenylamine was heat treated by immersing in denatured ethyl alcohol containing ½ gal. of benzene to 100 gal. of ethyl alcohol, the alcohol being boiled in a suitable still provided with a reflux condenser. The viscosity of the powder was originally 250 sec. by the so-called steel ball method, in a solvent mixture composed of benzene 50, ethyl alcohol 20, and ethyl acetate 30 parts at a temperature of 28 deg. C. After heating the powder in boiling ethyl alcohol for about 75 hours, using sufficient alcohol to keep the powder covered, the viscosity of the powder was reduced to 20 sec. and the content of the diphenylamine both converted and unconverted remaining in the powder was less than 0.02 per cent, a practically negligible amount.

The relative efficiency of various solvents for accomplishing the two objects of the treatment, namely the lowering of the viscosity of the resulting solution and the extraction of the objectionable diphenylamine are given in the patent disclosure. A modification involving the use of heating under pressure in an autoclave is also covered by the patent. (1,439,656. Dec. 19, 1922.)

Vulcanization of Rubber—Eloi Ricard, of France, has assigned to the Société Ricard, Allenet & Cie. the following patent for the vulcanization of rubber. Many accelerators, such as dimethylaniline, piperidine, anthraquinone, etc., are well known. This invention has to do with the use of furfuramide as an accelerator. From 0.5 to 2 per cent of the weight of the rubber will diminish the vulcanizing time 70 to 80 per cent and the temperature of the heating from 8 to 10 deg. C. (1,440,176. Dec. 26, 1922.)

Production of Alkali-Metal Cyanides—Present production following such processes as U. S. Pat. 1,322,195 yields a product containing 30 per cent of alkali-metal cyanide, the remainder consisting of alkali-metal carbonate and oxide, carbon, iron and sulphur. Other patents show how hydrocyanic acid may be prepared from these crude cyanides, and this is then liquefied, etc. The wide use of pure alkali-metal cyanides, however, has made it desirable to work out a method for the production of pure products from the crude material described above. The present invention has its foundation in the discovery that the reaction which is depended upon to free hydrocyanic acid from the furnace product may be reversed under suitable conditions, which are properly controlled. The hydrocyanic acid reacts with the carbonate of an alkali metal if the mass is held at a temperature of 200 to 500 deg. C. The process further deals with a new method for liberating hydrocyanic acid from the crude mass, consisting in subjecting it to a high concentration of carbon dioxide at comparatively high temperature. The carbon dioxide replaces the cyanide in the furnace mass and the hydrocyanic acid gas mixed with carbon dioxide comes off. This is then absorbed

at from 200 to 500 deg. as mentioned above in suitable converters, the carbon dioxide being returned to the process to liberate more hydrocyanic acid from another batch. (1,439,909. F. J. Metzger, assignor to the Air Reduction Co. of New York. Dec. 26, 1922.)

Purification of Hydrofluoric Acid—Henry Howard has assigned to the Grasselli Chemical Co. a process for the purification of hydrofluoric acid. It consists of bubbling the gases evolved by the action of sulphuric acid on fluorspar through a tower containing potassium sulphate solution. The silicon fluoride or hydrofluosilicic acid, which is the principal impurity, is washed out and the hydrofluoric acid is passed on. The tower must be kept hot enough so that no perceptible condensation takes place. By so operating the tower as to remove some of the solution after each run, the process can be made continuous. The product of the tower is potassium fluosilicate, which may be regarded as a final product or may be distilled again with sulphuric acid, producing hydrofluosilicic acid and potassium sulphate, which latter is then used over again in the absorption of hydrofluosilicic acid. The advantage of this process lies in the fact that a relatively poor grade of spar can be used in generating the hydrofluoric acid. In fact, gravelspar containing as much as 8 per cent silicic acid may be used to produce pure hydrofluoric acid. (1,439,960. Dec. 26, 1922.)

British Patents

For complete specifications of any British patent apply to the Superintendent, British Patent Office, Southampton Buildings, Chancery Lane, London, England.

Synthetic Thymol — 1-methyl-4-isopropyl-3-hydroxybenzene and an isomer thereof are prepared by treating meta-cresol-sulphonic acid with isopropyl alcohol and concentrated sulphuric acid or with isopropyl hydrogen sulphate at a raised temperature, and subsequently splitting off the sulphonic group. Examples are given showing the treatment in each case, and the sulphonic group is split off by distillation in steam, the oil obtained being freed from isopropyl-ether compounds—for example, by treatment with caustic soda—and the product fractionally distilled. From the after-runnings a product is obtained by crystallization from benzene representing a thymol-isomer, having a melting point 114 to 115 deg. C. The thymol itself may be recrystallized from ligroin. (Br. Pat. 186,202. J. Y. Johnson, London, assignor to Badische Anilin und Soda Fabrik. Nov. 155, 1922.)

Phosphate Fertilizers — Phosphoric compounds suitable for fertilizer, such as naturally occurring phosphates, bone meal and phosphoric slags, are converted into a form soluble in citric acid and partly soluble in citrates by intimate grinding with about one to one and a half parts of a suitable salt of the alkali or alkaline-earth metals, ammonium or magnesium. Double salts of the alkali metals and magnesium may also be used. The sulphates, chlorides, silicates and nitrates of these metals are mentioned as suitable salts, and either the artificially prepared compounds or the naturally occurring varieties such as kainite, schoenite, kieserite and carnallite may be employed. The process is stated to be of particular value in the treatment of Florida phosphates. (Br. Pat. 186,223. R. W. James, London, and Eisenwerk Ges. Maximilianshütte, Rosenberg. Nov. 15, 1922.)

Chlorinating Methane—In the chlorination of methane, steam is employed as a diluent to the reacting gases to moderate the violence of the reaction and at the same time to supply if necessary the heat for its initiation. In general 2 to 5 volumes of steam per unit volume of chlorine are used and temperatures above 650 deg. C. are avoided owing to the decomposition of steam and formation of oxide of carbon. Catalysts such as chlorides of copper, iron, and the alkaline earth metals may be employed, with or without porous carriers. The relative proportions of the reacting gases are dependent on the dimensions of the reaction tubes and upon the products required. Examples are given in which formation respectively of methyl chloride, methylene dichloride, chloroform and of carbon tetrachloride is promoted. (Br. Pat. 186,270. Holzverkohlungs-Industrie Akt.-Ges. and K. Róka, Baden. Nov. 15, 1922.)

Emulsions—Permanent emulsions of the kind in which the internal and external phases are constituted by aqueous liquid and oleaginous material respectively are formed from oleaginous materials which themselves possess water dispersing properties. These properties are acquired by heating or polymerizing the oleaginous materials without oxidizing them, or by heating or polymerizing after or with simultaneous oxidation, whereby the oleaginous material becomes gelatinated, sticky and elastic, such processes being generally known. This treated material may be directly emulsified with the aqueous liquid, or it may be diluted with a quantity of untreated material. The mixture, which also possesses water-dispersing properties, may be subsequently emulsified. The aqueous liquid may contain a little solid matter of a sticky nature—for example, glue or casein—and is added to the oleaginous material during vigorous stirring thereof. The resulting emulsion is soluble in oil and is particularly useful in painting and priming materials as described in specification 175,764, or in the manufacture of margarine or edible fats as described in specification 178,885. In an example 100 parts of refined soya oil are agitated at 250 deg. C. and treated with a current of air, steam or inert gas, preferably at 225 to 250 deg. C., until gelatinized. It is then cooled to 100 deg. C. and mixed with 300 parts of untreated oil, and into every 100 parts of this product 300 parts of aqueous liquid are vigorously stirred. This process is stated to be applicable generally to fatty oils containing linolic, linoleic or linolenic acid such as linseed, soya, cottonseed, sesame and ground-nut oils. (Br. Pat. 187,299. E. V. Schou, Palsgaard, Denmark. Dec. 13, 1922.)

Sewage Disposal—In order to obtain, in a relatively short period, an effluent of sufficient purity to allow of its being discharged into a river or estuary, the sewage to be treated is mixed with highly active sludge for a period of from 10 to 60 minutes in a tank provided with mechanical circulators and baffles. It is then passed into a series of tanks in which it is further aërated by means of air diffusers at the bottoms of the tanks. The mixture of sludge and sewage is then led into settling tanks, where the effluent is drawn off. The sludge, which is now a mixture of the original sludge and the new sludge from the treated sewage, is conveyed into a series of aërating tanks provided with air diffusers, and in these tanks the sludge again becomes highly active, the period of aëration being about 4 to 8 hours. From the last of the series of aërating tanks, the sludge is run to settling tanks, where more water is drained from it, the concentrated sludge being collected in a tank from which it is drawn by a pump and delivered to the initial mixing tank near the sewage entry pipe. (Br. Pat. 187,315. J. A. Coombs and Activated Sludge, Ltd., Westminster. Dec. 13, 1922.)

Desulphurizing Gases—Sulphuretted hydrogen is removed from gases by washing with a nickel salt solution with or without the addition of a salt incapable of precipitating nickel, or of a substance capable of forming a nickel compound soluble in alkaline solutions. The following substances are mentioned as being suitable: Ammonia, pyridine, salts of organic acids, ammonium chloride, ammonium sulphate and sodium chloride. When the sulphuretted hydrogen has been absorbed, with the formation of a precipitate of nickel sulphide, air is blown in, with the production of free sulphur and of a nickel solution suitable for re-use. An example describes the use of a solution containing nickel sulphate, ammonia and ammonium sulphate. (Br. Pat. 186,316. Ges. für Kohlentechnik, Dortmund. Nov. 15, 1922.)

Alloys—Bronze alloys, suitable for making articles for use in contact with superheated steam, wires for paper manufacture, springs for press-buttons, electric switches, and other purposes, consist of not less than 87 parts of copper, 4.5 to 10 parts of tin, 1 to 5 parts of nickel and not more than 5 parts of zinc. The copper and nickel are first melted together, the tin is then added, and finally the zinc.

A second specification by the same patentee covers a copper-zinc alloy having less than 40 per cent of zinc containing also nickel, manganese and iron, and not more than 3 per cent of aluminum. The alloy may consist of 40 to 55 parts of copper, 3 to 15 parts of

nickel, 1 to 3 parts of manganese, 1 to 2 parts of iron, 0.5 to 3 parts of aluminum, and less than 40 parts of zinc. The copper, nickel, manganese and iron are first melted together, the zinc then added, and finally the aluminum. (Br. Pats. 186,336 and 186,337. Allgemeines Deutsches Metallwerk Ges., Berlin. Nov. 15, 1922.)

Motor Fuel—Fuel oil for internal-combustion engines comprises an intimate mixture of mineral hydrocarbon oils, of 0.865 to 0.895 specific gravity, resin oil or oil derived from heating resin or a resinous body, and water, with or without distilled or recovered grease, fatty oils, tar distillates or cracked or polymerized mineral oil, the constituents being incorporated by ammonia or trimethylamine. The resinous and fatty constituents may be nitrated or sulphonated. The tar distillates used contain tar acids and boil between 250 and 280 deg. C. One example comprises 65 parts of kerosene, 10 to 12 parts of resin oil, or of a mixture of 20 to 30 per cent of resinous and 80 to 70 per cent of fatty oils, 2 to 5 parts of ammonia and 20 parts of water. (Br. Pat. 186,106. T. M. Hickman, Wolverhampton. Nov. 15, 1922.)

Book Reviews

THE SMITHSONIAN INSTITUTION'S STUDY OF NATURAL RESOURCES APPLIED TO PENNSYLVANIA'S RESOURCES. By *Samuel S. Wyer*, consulting engineer, Columbus, Ohio. Published for and distributed by the Smithsonian Institution, Washington. 1922. 150 9x12-in. pages, including nearly 100 full-page illustrations, maps or charts.

The State of Pennsylvania has undertaken to give to the grade schools and high schools special instructions regarding the natural resources of the state and the utilization of these resources by industry. In furtherance of this idea, this volume has been prepared and is to be placed in the hands of every seventh grade geography teacher of the state, and will be distributed as well to others who will use it for instruction purposes. However, the value of the work is not by any means limited to that state nor to educational purposes.

The author has given a splendid and a detailed review of fuel, mineral, forest and agricultural resources as well as a special exposition of some of the metallurgical and mineral industrial development of the state. Mr. Wyer has been, in his many publications, exceptionally successful in graphic presentation and clear demonstration of important industrial and economic facts by maps, charts and photographs. This particular volume seems to be a superlative exhibition of this unusual skill, for the many illustrations are in themselves of such great value that without the text the book would be of great interest.

Of necessity the technical information furnished in such a book is not new, but the methods of presentation are in many cases novel and worthy of consideration by any engineer. The photographs and diagrams of industrial processes and plants are in general either diagrammatic or developed from models such as those exhibited by the Smithsonian Institution. Anyone having an industrial demonstration to make of any of the industries covered in this book will do well to consult this work both for material and for suggestions as to methods of presentation. It is to be hoped that the Smithsonian Institution will find it possible to extend its work of this sort until every state of the Union can be served by as fine a book as this one for Pennsylvania.

R. S. MCBRIDE.

THE ANALYSIS OF RUBBER. By *John B. Tuttle*. 155 pp. Chemical Catalog Co., New York. Price, $2.50.

It is the author's intention that his monograph serve a two-fold purpose, namely, a guide to those chemists unfamiliar with rubber who may be called upon to analyze this type of product, and, for the benefit of the rubber technologist.

The book in general is of little, if any, value to a rubber technologist. The chapter dealing with the testing of crude rubber is entirely too limited and the methods outlined cannot be successfully used to differentiate between nonuniformity of shipments either from the standpoint of rate of cure or quality variation. The same applies to that part dealing with the sampling and testing of the various reinforcing and diluent pigments. In many cases the tests given are incapable of interpretation as far as their effects on the resultant compound is concerned, while in others some particular test of much importance is neglected.

A few instances may be mentioned, such as in the examination of oil substitutes (page 29) where the acetone extract is made for eight hours only, of mineral rubber (page 31) which determines the "acetone soluble" in four hours and makes no reference to the melting point of plasticity, of litharge (page 42) which is not examined for metallic lead and of gas black (page 48) where no reference is made to a test for grit.

Throughout, there is a tendency on the part of the author to endeavor to explain the effects and uses of the compounding pigments in rubber, which seem to indicate a lack of experience along this particular line, inasmuch as many statements conflict with present practice. He refers to magnesium carbonate (page 45) as not being as powerful an accelerator as the oxide, whereas it has no accelerating value, to aluminum flake (page 46) being used to replace zinc oxide, to mineral rubber (page 30) reducing blooming, and to air slaked lime hydroxide (page 51) as having but some accelerating effect. These are but few instances of many such statements to which exceptions may be taken.

It would have been well to have left out any reference to organic accelerators, or at least confined their mention to name only, as serious misconceptions may be formed by a close study of this particular chapter, a noticeable example of which is the statement that p-phenylene-diamine is of no importance commercially (page 40).

When the value of this monograph to the non-rubber technologist is considered it probably serves its purpose to some extent. However, it adds nothing to what has already been published along these lines, particularly by the various committees of several technical societies. It has, however, the advantage of having in compact form many data which are otherwise quite scattered as well as many references to work on rubber.

It may be well to call attention to the fact that the book does not seem to have been thoroughly proof-read. A particularly bad example is on page 25, where it states to "divide the percentage of rubber by the percentage of combined sulphur," whereas the opposite is the procedure, namely, dividing the sulphur by the rubber.

F. J. DUGAN.

THE ROMANCE OF THE GAS INDUSTRY. By *Oscar E. Norman*, librarian and superintendent of training and education, Peoples Gas, Light & Coke Co., Chicago. Privately published and for distribution by the author. 200 pages, including many illustrations. Price, $1.50.

As implied by its title this book is intended to popularize many of the historical and dramatic features of the gas industry and record in part "the romance of its achievements." "An attempt has also been made to relate entertainingly how obstacles in the way of production, distribution and uses of gas have been overcome; how gas has become the ideal fuel in the household and in the factory; and how its radiance rivals the sun."

The author has succeeded in bringing together many interesting items regarding the early history of the manufactured gas business; and he clearly sets forth some of its present day problems, quite obviously in an effort to defend the industry against some of the common misapprehensions and criticisms.

Starting as it does with the beginning of the universe and tracing some of the early stages of civilization through the worship of fire to the discovery of practical applications of gas in the household, the book attempts a most difficult task. As presented, it is doubtful whether the general reader would find a great deal of interest or value to him; but many in the gas business itself will doubtless be inspired to greater enthusiasm for the industry and may receive from the book suggestions as how diplomatically to meet public-policy problems which repeatedly tax the ability of even the most ingenious management. Particularly for the information of the young employee during his course of instruction as a cadet, this work should find general usefulness

R. S. MCBRIDE.

Technical News of the Week

Current Events in the Chemical, Metallurgical and Allied Industrial Fields
Legislative Developments—Activities of Government Bureaus, Technical Societies and Trade Associations

Chandler Medalist Points Out Waste of Atmospheric Pollution

Tons of Carbon Dioxide Now Wasted Must Some Day Be Utilized by Human Beings

THE CHARLES FREDERICK CHANDLER Foundation of Columbia University awarded its medal on January 9 at Havemeyer Hall to Professor Robert Eckler Swain of Leland Stanford University. On this occasion, according to the provisions of the award, the medalist delivered his lecture, and he chose for his subject, "Atmospheric Pollution by Industrial Wastes." Dean Pegram introduced him, explaining that the Chandler Foundation was established in 1910 by the subscription of friends of Professor Chandler to a fund that should provide the occasion for a lecture by some eminent chemist and a gold medal to be then and there presented to him for services rendered. Seven medals have thus far been awarded as follows: Professor Chandler himself, Dr. Leo H. Backeland, Dr. William F. Hillebrand, Dr. William R. Whitney, Professor F. G. Hopkins, Dr. Edgar Fahs Smith and Prof. Swain for his achievements in the application of chemistry to public affairs.

Dr. Swain said he had chosen his subject to emphasize the need of conservation of our materials. Black clouds of smoke are more truly indications of waste than they are of industry, and it is well to bear in mind that through chemical changes our wastes may be brought to use. The greatest atmospheric waste is in CO_2. The people of the U. S. exhale annually no less than 45,000,000 metric tons of it. It is present at the ratio of 3:10,000 in the air over sea and land except over large cities, where it sometimes runs up as high as 6:10,000, although it soon diffuses to the standard ratio.

Sees Artificial Photosynthesis

Nature is constantly consuming this gas in plant life, but the process is slow. Indeed if the human race is not to be checked and turned back, a more rapid method of using the sun's rays to synthesize fuel from CO_2 and water must be discovered. The sun produces 900 Calories per square meter per hour on the earth's surface and the speaker believed that the photosynthesis of sugar from CO_2 and water by this means would be brought about some day.

He called attention to the fact that the U. S. consumes half the coal and two-thirds of the petroleum produced in the world, while our water power lies mostly dormant. "Waste," said he, "is raw material in the wrong place." In mining coal we have been shockingly wasteful, taking out hardly more than half of that which is in the mines; we are wasteful in our methods of firing and in our losses through incomplete combustion. The smokeless combustion of coal is now entirely feasible. The most wasteful of all uses of coal in proportion to that consumed is in house furnaces and stoves. The day may come when all municipalities will prohibit the burning of bituminous coal in direct firing. Smoke was once a necessary evil, then it became a nuisance. To-day it is sheer waste.

Smelter Fume Problems

Most smoke litigation has had to do with SO_2 production by smelters, he continued, referring in detail to the field work and investigations made in relation to smelter smoke troubles—how they have been overcome by the production of sulphuric acid, by precipitation of smoke, including arsenic and other wastes by Cottrell precipitators, the use of bag filters and by the recognition of the obvious fact that gases are disposed to rise when they are heated. If SO_2 pollutes the atmosphere to the extent of $\frac{1}{4}$ of 1 per cent it will make it heavier than the surrounding air, but if raised only 1 deg. C. the difference will be overcome. The important factor has been the heating of gases 75 degrees above the prevailing temperature and sending them through stacks 450 feet high.

The presentation was made by Professor Chandler himself with his characteristic fecility.

Canadian Asbestos Mines Being Developed

Development work is now under way on asbestos claims in British Columbia located on Mount Sprout, 24 miles south of Revelstoke. These claims are located at an elevation of 4,200 ft. above sea level and about 2,800 ft. above the nearest railway. The location of the claims, necessitating the expenditure of a considerable amount of capital to bring them to a profitable producing stage, is the only obstacle to their rapid development.

Government May Sell Calcium Arsenate

Joint Resolution Would Provide for Distribution of Fertilizer and Insecticide at Cost

A joint resolution, appropriating $10,000,000 to permit the President to sell sodium nitrate and calcium arsenate to farmers at cost, was passed by the Senate last Saturday. The resolution was introduced by Senator Smith of South Carolina, a member of the farm bloc. While the initial appropriatino is $10,000,000, the President is permitted to use the money as a revolving fund, so that the sales of these commodities to farmers may be pyramided and the business conducted on a large scale.

The scope of the resolution was broadened to include calcium arsenate upon a motion made by Senator Harris of Georgia. He pointed out that the government already had 28,000 tons of sodium nitrate which could be used, but that there was a great necessity for further supplies of calcium arsenate.

Plan to Stop Waste

Secretary of Agriculture Wallace, in a letter sent last week to Senator Harris, of Georgia, said:

> It is undoubtedly true that a great deal of calcium arsenate was wasted last year through misapplication. We feel, however, that failure to secure satisfactory results from its use was generally due to lack of care in making the applications and in complying with the conditions necessary to secure results rather than to any difference as to the time of application.
>
> The method of weevil control through the use of calcium arsenate as recommended by the entomologists of the Department of Agriculture has beyond any question given satisfactory results when carefully followed. The department, however, is not satisfied that everything has been learned about it that can be, and is preparing to carry on extensive investigations in the coastal plain section of the cotton belt to see what improvement in method of control can be effected.
>
> We do not believe that a survey of the situation through the reports of the country demonstration agents would necessarily afford us the information necessary to settle all questions of this kind.
>
> This whole subject will be thoroughly considered at a cotton conference to be held in Memphis early in February, at which extension men, experiment station directors and leading cotton farmers from all over the South are expected to be present. Every phase of the question will be discussed at this meeting and if any modification of the department's instructions for the application of calcium arsenate are deemed advisable they will be made.
>
> The new method of control recently announced by the Florida experiment station, if proved practicable for other sections of the country, will materially reduce the expense of applying calcium arsenate, as it contemplates but one application of the poison, and that when the cotton is very small.

Engineers Honor Caetani at Banquet

Distinguished Gathering Hears New Italian Ambassador's Message of Good Will—Engineer Needed in Public Life

POLITICS needs a larger dose of logic and practical sense, Prince Gelasio Caetani, new Italian Ambassador to the United States. declared in an address at the annual dinner of the American Engineering Council of the Federated American Engineering Societies held at the Chevy Chase Club, Washington, Thursday evening, Jan. 11. These qualities of the engineer, he said, would bring great advantages to public affairs.

The Ambassador, himself an engineer and for 13 years previous to the war a resident of the United States, said that his principal aim is to strengthen the bonds of friendship and esteem between this country and Italy. Recalling his engineering career in the West following his graduation from the Columbia University School of Mines in 1903, Prince Caetani said that he was returning not only as a diplomat but as an engineer and friend of America.

Engineering, he continued, is destined to play a powerful rôle in modern civilization. Italy he described as a nation born again. Its potentialities industrially, he said, were bound to make it a great force in world commerce. The electric industry especially was making rapid strides and all branches of engineering activity were developing constructive effort, in which Italy's greatest asset was an abundance of efficient labor and in which American capital and machinery were needed.

The Ambassador's address was heard by leading engineers and public officials from all parts of the country. Dean Mortimer E. Cooley of the University of Michigan, president of the American Engineering Council, presided. Other speakers were Calvin W. Rice of New York, secretary of the American Society of Mechanical Engineers, and John J. Tigert, United States Commissioner of Education.

Pan-American Unity

Mr. Rice, who recently returned from South America, where, accompanying Secretary Hughes and party to the Brazilian Centennial Exposition, he acted as an envoy of the American engineering profession, said that definite steps have been taken to promote Pan-American unity among engineers. Through the efforts of the Department of Commerce, Mr. Rice reported, the idea of standardization was spreading in the South American countries, all of which are contemplating legislation to establish a standardization bureau, as recommended by Secretary Hoover.

A permanent organization to carry out the resolutions of the recent International Engineering Congress at Rio de Janeiro has been effected, according to Mr. Rice, who said it was now proposed to call a meeting of the Pan-American nations to develop the dream of a transcontinental railway. He predicted that the engineer would be increasingly influential in bringing about Pan-American solidarity and in the attainment of international peace.

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GELASIO CAETANI
Mining Engineer and Newly Appointed Italian Ambassador

Engineering in Japan

Elmer A. Sperry of New York, reporting upon his mission to Japan, told of the remarkable progress being made by the Japanese in industry and in engineering, saying that even England had come to Tokio to gain new ideas in warship construction. Mr. Sperry described the huge size of the industrial plants and machinery used in Japan as exceeding anything known in the United States. The Japanese people, he said, were keeping the disarmament compact to the letter, while the engineers of Japan were aiming to promote a better international understanding by effecting closer relations with the engineers of other nations.

Caetani's Address

The Italian Ambassador was warmly received by his fellow engineers, and his remarks were frequently applauded. Extracts from his speech follow:

"Your kind invitation to be a guest at the annual banquet of the Federation of American Engineering Societies reached me while I was preparing to leave for the United States. I read it with deep satisfaction, for it made me feel that, besides sailing for America as Italy's Ambassador, I was going home to my old stamping grounds somewhat still invested with the qualifications of an engineer.

"We pride ourselves in saying: 'Once an engineer, always an engineer.' Whatever may be the course of life followed by one of us, it will always be marked by the indelible seal of the scientific, practical and logical training to which an engineer is subjected during the early years of life.

"I judge that many of my colleagues present at this banquet have followed in life most disparate occupations which often had little to do with engineering; such has been my personal experience during the agitated years since the beginning of the war. Well, gentlemen, we can say that in each and every occupation we have felt and thought and acted chiefly as engineers.

"Some have made the remark in criticism that engineers lack political intuition and ability; I would answer that a larger dose of logic and positiveness applied to politics would bring great advantages to public affairs.

"Whatever the case may be, it is very agreeable that politics bear little weight in the relations between Italy and the United States. Between our two countries there has never existed political rivalry or serious commercial competition; our relations have been confined almost exclusively to contacts of labor, of engineering, of commerce, of science and of art.

"Italy's largest asset is the remarkable quality of its people's labor; sober, intelligent, hardworking and plastic, the Italian peasant or workman will in an incredibly short time become efficient in whatever he is called to do. While I was carrying out fortification works along our front, many officers of the allied powers expressed to me their admiration for the remarkable skill of our peasant-soldiers compared with their own.

"Of all this many Americans are perhaps not yet fully aware for the reason that the wave of Italian emigration which shortly preceded the war was so sudden that it was not utilized to best advantage. Most of our skillful laborers, insufficiently guided, agglomerated in the congested cities of the East, contenting themselves with the first job they came across, instead of taking up occupations more congenial to their nature and for which they were better prepared.

"Specialization of Italian labor will bring great advantages to the large engineering industrial and agricultural enterprises which are still to be achieved in the United States.

Italy's Natural Resources

"Much, however, is still to be done in Italy itself; its resources are far from being fully developed and there are many opportunities for American capital, machinery and technical organization to be usefully applied in Italy.

"The electric industry in our country has made rapid strides and as to percentage of utilized water power, Italy ranks, I believe, foremost in the world. Electricity is our 'white coal' and at the present day its use results in an economy of about two billion lire, otherwise necessarily spent on fuel imports.

"In 1898 the electric energy developed in Italy amounted only to 87,000 kw.; it increased to 426,000 kw. in 1908, to 1,240,000 kw. in 1918 and power plants for some other 1,000,000 kw. are planned

or under construction. About 800,000 kw. are still to be developed.

"On the Tirso in Sardegna a reservoir of 416 million cu.m. capacity is being constructed. It will be the second largest in the world, ranging immediately after the Assuan dam and will develop about 50 million kw.-hr. and irrigate 60,000 acres of land.

"My experience in the United States has been my most valuable asset in life. Before leaving Rome, at a dinner given to me by the Italian engineers, I exhorted the young engineers to get a few years of practical training in America. I hope you will do likewise by encouraging your students and graduates to spend some time in Italy, as nothing broadens the mind more than to breathe an atmosphere different from that of one's own town and country.

"Italy's atmosphere is vibrating with wonderful reflexes of a long and glorious past and full of promise for a remarkable future.

"It is a great art in life to single out and appreciate other people's good qualities and try to make them your own.

"Similar intercourse between our young students who, in a few years, will be the active men of our countries, will be a powerful factor in reaching the principal and ultimate aim I will have in view in carrying out my duty as Ambassador—that is, to strengthen the bonds of friendship and esteem between Italy and the United States."

Would Continue to Hold Foundation Patents

Department of Justice Asks Provision in Winslow Bill to Exclude Chemical Patents From Returned Alien Property

The Department of Justice is urging that a safeguarding clause be inserted in the Winslow bill, which authorizes the restoration of $10,000 trusts held by the Alien Property Custodian to their German and ex-enemy owners, specifically excluding the 4,700 patents which are now held by the Chemical Foundation. H. J. Galloway, special assistant to the Attorney-General, informed the committee last week that the government desired to have this additional protection in order that the patents, listed at nominal valuations, might not be turned back.

Present indications are that the government's motion to get back the Chemical Foundation patents will be heard in the District Court of Delaware about April 15, Mr. Galloway said. He informed the House Interstate and Foreign Commerce Committee, which had been conducting hearings on the Winslow bill, that all of the necessary preliminary legal papers had been filed and that only the fixing of the date of argument held up consideration of the case.

"If the Chemical Foundation has any title at all to the ex-German patents, it is an absolute title," Mr. Galloway said. However, he contended that the sum paid for the patents was inadequate and that Francis P. Garvan, when Alien Property Custodian, had arranged for the sale of the patents to the Chemical Foundation, so that he stood in the position of both buyer and seller.

This, Mr. Galloway said, was manifestly lacking in equity. The value of the patents, he said, had been variously estimated from $10,000,000 to $100,000,000, one patent for neosalvarsan being worth more than the total amount paid for all of the German patents.

The Department of Justice wants Congress, in passing any legislation dealing with the question of alien property, to exclude the patents held by the Chemical Foundation, but Mr. Galloway made plain that it desired to have the rights of the American industries now using them under a license plan to have ample protection. If the patents are restored it will be up to Congress to direct what is to be done with them.

Engineering Council Reviews Accomplishments

Encourages Participation of Professional Men in Public Affairs

The engineering profession is on the eve of great developments, Dean Mortimer E. Cooley of the University of Michigan declared in his address to the American Engineering Council of the Federated American Engineering Societies at the annual meeting of the Council held at the Cosmos Club in Washington, Jan. 11 and 12. Dean Cooley, who was unanimously re-elected president of the Council for 1923, struck the keynote of the gathering in saying:

"We are, I feel, entering upon a new era. The engineer, not so much in the technical as in the social sense, is about to take that part in the world which rightfully is his. I am speaking not of civil engineering, mechanical engineering, chemical engineering, electrical engineering or any other branch of engineering, but of the engineering profession as a whole."

Dean Cooley, reviewing the year's work, said that substantial results had been achieved, and that the Federation was progressing gradually and surely toward the fulfillment of its mission. His trip through eighteen states last spring, he said, inspired the conviction that the Federation was a necessary instrument of organized engineering and a source of opportunity for service both within and without the profession that exceeded the hopes even of its founders. The waste report and the report on the two-shift day in continuous industry he characterized as two outstanding accomplishments of world importance. The two-shift report is now available in printed form, and the committee which prepared it has been formally discharged by the executive board of the Council. A third undertaking of similar magnitude was likely to be set in motion in the near future, Dean Cooley announced.

The report of Executive Secretary L. W. Wallace, who was re-elected by the executive board, showed that the activities of the Federation are multiplying rapidly. Relations with government departments are becoming more extensive and more intimate and in every direction the Federation is winning increased recognition. A letter from Secretary Hoover, read at the meeting, asserted that the Federation was one of the most influential existing agencies in the promotion of public good.

Federal legislation in which the Federation through the executive secretary has taken an active interest includes the Sterling-Lehlbach bill, topographic mapping, helium, national hydraulic laboratory and revision of the mining laws. John R. Freeman was the principal witness at the hearings on the question of a national hydraulic laboratory, the need for which he pointed out in an exhaustive report. Mr. Wallace asserted that the bill for mining law revision should receive the active attention of all engineers. Adoption of an amendment increasing the appropriation for topographic mapping from $325,000 to $500,000 was called by Mr. Wallace "a distinct victory auguring well for the Temple bill." He reported a tendency to delay action on the Sterling-Lehlbach bill, and this he described as unfortunate.

Engineering Ideals

A report of the committee on engineering ideals, expressing the desire of the Federation to bring to the attention of the engineering colleges throughout the country the need of pointing engineers toward leadership in public affairs, was adopted. The committee was headed by Prof. Joseph W. Roe of New York University. The Council adopted the report of its patents committee requesting "that a joint commission be appointed by the Senate and House of Representatives to investigate the needs of the Patent Office, as to both personnel and physical equipment, and that it be requested to report at an early date, so that the present session of Congress may take appropriate action."

At the suggestion of the Spokane Engineers Club, transmitted through J. C. Ralston, the Council voted to refer to its committee on public affairs with its indorsement a proposal to recommend to President Harding the selection of "the engineering type of man" as Secretary of the Interior to succeed Mr. Fall, who has resigned. J. Parke Channing, head of the committee, supported this proposal, saying that it was in keeping with the engineering movement to establish a Department of Public Works. Eighty per cent of the activities of the Interior Department, it was asserted, concern engineering problems. The speakers made it plain that no political considerations were involved.

Vice-presidents were elected by the Council as follows: J. Parke Channing and Calvert Townley, New York; Philip N. Moore, St. Louis; Gardner S. Williams, Grand Rapids, Mich. H. E. Howe of Washington was elected treasurer.

Fertilizer Man Attacks Ford Shoals Offer

C. H. MacDowell Points Out Effect on Water Power Act in Establishing Such a Precedent

Vigorous opposition to acceptance of Henry Ford's proposal for purchase of the Muscle Shoals government project was voiced in an address before the Chicago Woman's Club in Chicago, last week, by C. H. MacDowell of the Armour Fertilizer Works.

"The Ford proposal, if accepted, nullifies the fifty-year clause of the water power act," said Mr. MacDowell. "The government builds the plants, while the Ford company pays no taxes on the costs and takes no risk of the dams holding.

"The company acquires special privileges and subsidies from the government which enable it to compete unfairly with companies putting up their own funds. It obtains a private power monopoly for 100 years or more and obtains a strangle hold on the industrial development of that section through its power control. Certainly a large block of economic power to be entrusted to the administration of a private company!"

Danger of Special Legislation

Mr. MacDowell pointed out that the Federal Trade Commission, in its second annual report, forcibly draws the attention of Congress to the danger of special legislation, the effect of which must be nullification of the national policy in respect to water power, which has been declared by Congress after investigation and study covering more than a decade.

"The commission does not mention by name Muscle Shoals or the Ford proposal," he continued, "but it could have meant nothing else in the following statement:

" 'There are movements on foot in several quarters to secure for certain sites or streams special legislation which if approved would constitute a partial repeal of the federal water power act, and would eventually result in the progressive disintegration of our present national water power policy.' "

Will Attempt to Collect Literature on Cellulose

Dr. C. J. West, chairman of the committee on bibliographies of the Technical Association of the Pulp and Paper Industry, has offered to act for the cellulose division of the American Chemical Society as a receiving center for bibliographies relating to any branch of cellulose chemistry. It is hoped that all of those having such bibliographies will send a copy to Dr. West, National Research Council, 1701 Massachusetts Avenue, N.W., Washington, D. C. Dr. West has kindly offered to assemble all material received and make it available to anyone interested. It is hoped that a large amount of duplication of effort can be avoided in this way.

Tear Gas Adopted by Washington Police Force for Mob Control

Police and other officials of the District of Columbia had a striking demonstration of the effectiveness of tear gas when one of the guns recently invented by Captain L. M. McBride, of the Chemical Warfare Service, was accidentally opened in the office of the chief of police. The chief himself was temporarily blinded, as were a number of employees in the District Building. The gas found its way into the halls and elevator shafts, with the result that hundreds of persons participated in this accidental demonstration of its effectiveness.

As a result of this incident, it was revealed that the Washington police department is equipping all patrol wagons, police stations and jails with this gun.

Reported Used by Burglars

Officers of the Chemical Warfare Service are impressed with the significance of the report that the theft of the Schoellkopf jewels in New York City was made possible by the use of gas. If the use of gas is found to be effective in the highly practical art of burglary, it is believed that the police and military authorities will be more ready to admit that the Chemical Warfare Service has developed an agent with the greatest potentialities in the control of mobs and other law breakers.

Agricultural Chemists Develop Poison for Barberry Bush

Intensive experiments on the part of the office of cereal investigations of the Department of Agriculture has developed two chemical methods for the eradication of the barberry bush. This bush spreads a rust to grains and grasses. A campaign is now in progress throughout New England and the Middle West looking to the eradication of this growth. More than forty chemicals were tried in the experiments. It has been found that rock salt and sodium arsenite give uniformly good results. It is anticipated that large quantities of these materials will be employed in future eradication work.

Under-Fertilization of German Farms Promises Demand for Chilean Nitrate

During 1922 Germany used some 350,000 metric tons of atmospheric nitrogen for agricultural purposes. To this may be added not more than 100,000 tons of Chilean nitrate. This indicates that German farms are being under-fertilized by 40 per cent.

Since no important expansion of atmospheric nitrogen production is expected in the near future, the general opinion in Germany is that there should be large importations of Chilean nitrate this year. Indications are that an active effort now is being made to provide for the financing of large purchases.

F. C. Brown Made Head of Bureau of Standards

Assistant Director Assigned Temporarily to Post Vacated by Stratton

Since a considerable period is likely to elapse before a director will be chosen for the U. S. Bureau of Standards, importance is attached to the designation by Secretary Hoover of Dr. Fay C. Brown as the acting director, who will direct the work of this important subdivision of the Department of Commerce during the interim.

Dr. Brown was born in Washington, Ohio, in 1881. He was graduated from the University of Indiana, in 1903. He did graduate work at the University of Illinois, at the University of Chicago and at Princeton. After taking his doctor's degree at Princeton in 1908, he did further work at that institution as an Ogden Fellow. On the completion of that work he accepted a position as instructor in physics and engineering at the University of Illinois. Later he joined the faculty of the University of Iowa. He was engaged in that work when the United States entered the war. He entered the military service and was assigned to the Ordnance Department, where he was placed in charge of the testing and ballistic work on airplane bombs. While in the military service he attained the rank of major.

At the end of the war, Dr. Brown had the opportunity to choose between the professorship of physics at the University of Iowa and the position of assistant director of the Bureau of Standards. He accepted the latter post where he has been engaged continuously since.

Accomplishments in Research

While Dr. Brown regards as his principal achievement the work that he has done in directing the Bureau which Secretary Hoover likes to refer to as "the largest physical laboratory in the world," he has done a great deal of research in addition to his administrative duties. He is proud of his work in thermionics, since that proved to be a sort of forerunner of radio amplification. He did important optical work and has made an intensive study of the electrical and mechanical properties of selenium and selenium crystals. With Joel Stebbins, the astronomer, he took an important part in starting the work on the mechanical measurement of the intensity of double stars.

Wages Cut in Austrian Chemical Industry

Wages in the Austrian chemical industry were cut 11 per cent on Dec. 1, according to advices sent the Department of Commerce from Vienna. The difficulties of the chemical trade have been increased by the action of German chemical manufacturers in declining to extend credit to Austrian firms for longer than 30 days and by their demand for partial or full payment of the order, in some cases at the time it is placed.

Federal Suit Instituted Against Butterworth-Judson Corporation

Heavy Chemical Company Called to Account for Expenditure on War-Time Picric Acid Plant

THE FIRST of a series of suits to be brought by the government to recover damages on war contracts was instituted last week in the federal court of New York. The suit was brought at the instance of Attorney-General Daugherty and Colonel William Hayward, Federal Attorney, through Victor House, Assistant United States District Attorney.

In the initial suit Mr. House directs that Henry G. Atha, James O'Grady and Thomas G. Haight, receivers in equity for the Butterworth-Judson Corporation, account for $1,151,000 expended by the corporation from a revolving fund of $1,500,000 advanced by the government.

History of Picric Acid Plant

According to Mr. House the revolving fund was advanced on a contract consummated by the government with the Butterworth-Judson Corporation in May, 1918, for the construction of a plant at New Brunswick, Ga., by the defendant corporation, for the manufacture of 72,000,000 lb. of picric acid. The construction was to cost $7,000,000.

Approximately $8,500,000 was expended and the plant was about 50 per cent completed when the contract was terminated by the cessation of hostilities.

In April creditors instituted suits in New York and New Jersey for the designation of a receiver for the defendant corporation, it being alleged it was unable to satisfy maturing obligations.

Funds Were Banked

It is alleged by the government that the revolving fund advanced to the defendant was partially deposited with various banks in this city, which Mr. House contends was a wrongful conversion of trust funds, and that the banks are not entitled to retention of the deposits.

At the time of the suit for a receiver the defendant corporation had $528,009 deposited with the Chase National Bank, American Exchange National Bank, New York Trust Company and National Newark & Essex Banking Company.

Discussing the suit Mr. House said: "When the advance of $1,500,000 was made the government required a surety company bond conditioned upon an appropriate accounting of the advance. Eight surety companies joined in this bond, the American Surety Company of New York being the company through which it was written. These surety companies are joined as parties defendant, and the court is asked to direct them to pay any balance of the $1,500,000 not otherwise paid."

The main Butterworth-Judson plant is located in Newark, N. J. There has been a large depreciaiton in the value of the plant since the war ended. It is being operated by the receivers, who recently received authority from the court to enter into contracts for the coming year. It is understood that reorganization is being planned.

Company Asks Damages

The original contract provided that if it were terminated before 18,000,000 lb. of picric acid were delivered, the contractor should become entitled to liquidated damages of 3 cents a pound on the undelivered portion of such 18,000,000 lb.

No picric acid was ever manufactured or delivered under the contract, and one of the large items of dispute in this suit is whether the Butterworth-Judson Corporation is entitled to $540,000 as liquidated damages under the termination clause of the contract. The government will contend that this provision for liquidated damages was not intended to become operative unless the plant was completed and deliveries of picric acid under the contract had been begun prior to the termination of the contract.

French Consider Compulsory Use of Alcohol in Motor Fuel

France is considering the establishment of a Bureau of Alcohol in one of its Federal departments, according to advices to the Department of Commerce.

In addition, legislation practically is assured which will require the admixture of at least 10 per cent of alcohol with all motor fuel. Reports have been submitted by chemists to the Chamber of Deputies setting forth that a mixture of 45 to 55 per cent alcohol can be used in automobile engines without any change from the designs now using gasoline only.

Fiber Companies Merge

The American Vulcanized Fiber Co., the Keystone Fiber Co., both of Wilmington, Del., and the National Fiber & Insulation Co., Yorklyn, Del., have been merged under the name of the National Fiber Co. Headquarters will be maintained at Wilmington, and present plants there and at Yorklyn and Newark, Del., will be continued in operation. J. Warren Marshall, formerly head of the National Fiber & Insulation Co., has been elected president of the new organization; Claude W. Sutton, heretofore head of the American Vulcanized Fiber Co., will be vice-president of the consolidated company, in charge of sales.

Engineers Urge National Hydraulic Laboratory

Hearty support for a national hydraulic laboratory is coming from all parts of the country and from the men engaged in all branches of engineering, the Senate sub-committee was told during the course of a hearing on January 10, at which Senator Ransdell's bill providing for the establishment of a National Hydraulic Laboratory was considered. The principal testimony was given by John Lyle Harrington, of Kansas City, the president of the American Society of Mechanical Engineers; Gardiner S. Williams, of Detroit, a hydraulic engineer, and John C. Ralston, of Spokane, Wash., a civil engineer.

The sub-committee was told that all branches of engineering are coming to attach greatly increased importance to research. The hydraulic laboratory would do much to supplant rough and ready knowledge of hydraulic formulas and practice by exact knowledge, it was said. Mr. Harrington cited a number of specific cases in which there have been wide divergences of engineering opinion on fundamental problems in hydraulics. In each of these cases the completion of the work demonstrated absolutely that certain theories advanced by eminent engineers were wrong. These differences never would have arisen had accurate basic information been available. As it is, Mr Harrington told the Senators, most hydraulic problems are solved by the application of judgment rather than in a scientific manner. Were it possible to reduce the margin to provide for the unknown, great economies could be effected in the construction of flood control works, he asserted.

Accurate Formulas Lacking

Mr. Williams referred to the existing controversy among engineers over the spillway problem at New Orleans, as being typical of the great dearth of scientific data which can be applied to the control of rivers. He is at a loss to undestand, he said, why there should be opposition to a national hydraulic laboratory from the Corps of Engineers —the agency which would benefit most from its operation. The Mississippi River Commission, he declared, would benefit particularly, as he believes many of their theories could be proven absolutely if studied at such a laboratory.

The committee was told that hydraulic formulas are not of scientific character. There is need, it is stated, for research work on all the problems of water, but since such a laboratory must be confined in the start to the more pressing problems, it was predicted that its early work would be confined to the problems of river hydraulics. It was suggested that the laboratory should be made available to the engineering societies and to individual engineers for the working out of special problems, in addition to those which come before the Corps of Engineers, the Geological Survey, the Bureau of Standards, and the Reclamation Service.

Engineers Plan World Congress in 1926

Sesqui-Centennial Exposition in Philadelphia to Be Scene of International Meeting

A conference on the plans for an international engineering congress, to be held at the time of the Sesqui-Centennial celebration in Philadelphia, was held in New York City, Jan. 9. The meeting was called to order by Richard L. Humphrey, chairman, who outlined the purposes of the conference and reviewed briefly the events leading to the calling of the meeting.

The movement to hold a world congress of engineers in 1926 was initiated by the Engineers Club of Philadelphia in December, 1921, and at that time an invitation was extended to the American Society of Civil Engineers, the American Institute of Mining and Metallurgical Engineers, the American Society of Mechanical Engineers, the American Institute of Electrical Engineers, and the American Society for Testing Materials. Each was requested to appoint two representatives to meet with a committee of the Engineers Club in Philadelphia to formulate a plan for such a world congress.

An outline of the plan of organization for such a congress was prepared by the secretaries of the four founder societies in May, 1922, and was subsequently approved by the presidents of these societies. This plan proposed a board of management, which was duly elected, at an organization meeting in November, 1922. George S. Webster was appointed temporary chairman and Charles E. Billin temporary secretary.

Will Promote Welfare of Profession

At the meeting last week the committee considered the advisable scope of the congress, methods of financing, relation of meetings of engineering societies to the sessions of such a congress and publicity.

It was brought out in the discussion that this meeting represents another step toward bringing the engineers of the different countries of the world closer together, taking up the threads of contact that had been broken by the war and fostering a better understanding of the relation of the engineer not only to the technical problems of the world, but to the reconstruction of our present day civilization, to which the engineer has already contributed so much in a material way.

Personal

Richard V. Ageton, of the Bureau of Mines staff, who has been doing examination work for the War Minerals Relief Commission, is acting as assistant chief mining engineer of the Bureau of Mines.

Dr. Raymond F. Bacon and Dr. J. Enrico Zanetti have been presented with Distinguished Service Medals for their services in France. Dr. Bacon was Colonel of the Technical Division, Chemical Warfare Service, American Expeditionary Forces, and Dr. Zanetti was Lieutenant Colonel, Liaison Officer, Chemical Warfare Service, American Expeditionary Forces. Presentation was made by General Bullard, Governors Island, New York.

Dr. H. E. Barnard, director of the American Institute of Baking, spoke before the Indiana Section of the American Chemical Society, Jan. 9, on "The Possibilities of Chemical Research in the Baking Industry."

E. L. Bullock of New York, formerly an official of Katzenbach & Bullock, manufacturers of chemicals, and recently connected with the Tidewater Chemical Co., New York, has resigned from the latter company.

M. R. Campbell will serve as acting director of the United States Geological Survey during the absence from Washington of Philip S. Smith.

Edmund S. Davenport, formerly research metallurgist of the Eastern Malleable Iron Co., Naugatuck, Conn., is now with the Westinghouse Lamp Co., Bloomfield, N. J.

Dr. Thomas B. Downey is the present incumbent of the industrial fellowship in the Mellon Institute of Industrial Research of the University of Pittsburgh, established by the Edible Gelatine Manufacturers of America, Inc., for the purpose of ascertaining the real food value of edible gelatine in the American dietary. In addition to experimental investigations, a correlation of available facts regarding edible gelatine will be made, to be held at the disposal of all users.

Brigadier-General Amos A. Fries, chief of the Chemical Warfare Service, spoke before the Engineers Club, Baltimore, Jan. 9, on "Gases Used in Warfare—Protection Against Them and Their Peace-Time Uses."

Dr. Morris S. Kharasch, formerly national research fellow in organic chemistry at the University of Chicago, has been appointed associate professor of organic chemistry at the University of Maryland.

Dr. Richard C. Lord, at one time instructor at Washington and Lee University and later engaged in industrial chemistry, has been elected assistant professor of chemistry and physics at Kenyon College, Gambier, Ohio.

Dr. E. Z. Lynn of the college of pharmacy, University of Washington, Seattle, gave an interesting address at a recent meeting of the Puget Sound Section of the American Chemical Society on "The Manufacture of Zinc and Barium Products."

S. Joseph McGrath, formerly head chemist for the Obrien Varnish Co. of South Bend, Ind., has been appointed superintendent of the Phelan Varnish Co. of St. Louis, Mo.

Dr. Josiah H. Penniman was elected provost of the University of Pennsylvania, on Dec. 27, 1922. He has been acting provost since the resignation of Dr. Edgar Fahs Smith about three years ago.

Dr. Otto M. Smith, formerly in charge of research for the Roseville Chemical Co., Roseville, Indiana, has been appointed assistant professor in quantitative chemistry at Iowa State College, Ames, Iowa.

Prof. O. F. Stafford, head of the department of chemistry of the University of Oregon, has returned to his university work at Eugene, after a leave of absence of four years' duration devoted to industrial research in the field of waste wood utilization by destructive distillation.

E. B. Swanson has been promoted to be administrative assistant to the Director of the Bureau of Mines. As private secretary to the Director, Mr. Swanson for some time has been discharging the duties of administrative assistant, without having had the title or the salary which goes with that position. Mr. Swanson is a graduate of the University of Washington.

F. G. Thompson of Seattle, Wash., has been elected chairman of the Puget Sound Section of the American Chemical Society at the annual meeting held at the University of Washington. A. G. Bissell has been elected vice-chairman; R. W. Ellison, secretary; G. C. Howard, treasurer, and H. K. Benson, councillor.

L. M. Tolman has been appointed technical director of Wilson & Co., following a reorganization of the company's technical and laboratory activities. The work of the chemical laboratory has been divided into two divisions: The Technical Division, with E. A. Schlesser in charge, and the Food and Sanitary Division, with F. W. Kurk in charge. Mr. Tolman will continue to supervise the work of both divisions.

F. M. Turner, Jr., was elected a councillor of the New York Section of the American Chemical Society, and not F. M. Turner, as given on page 1190 of our Dec. 13 issue.

Dr. Charles D. Walcott, secretary of the Smithsonian Institution, president of the National Academy of Sciences, and formerly director of the United States Geological Survey, has been elected president of the American Association for the Advancement of Science.

Dr. E. R. Weidlein, director of the Mellon Institute of Industrial Research, addressed the Indiana Section of the American Chemical Society, Jan. 12, on "The Value of Industrial Research."

The following men have been elected to membership in the Club de Engenharia (South America), which organization corresponds to an amalgamation of the four national societies in the United States: Josiah E. Spurr, Louis J. Hirt, Verne L. Havens, A. W. K. Billings, Edward Wegmann, Samuel M. Vauclain and Calvin W. Rice.

Market Conditions

In Chemical, Metallurgical and Allied Industries

A Survey of the Economic and Commercial Factors That Influence Trade in Chemicals and Related Commodities
Prevailing Prices and Market Letters From Principal Industrial Centers

A Year of New Records in the Petroleum Industry

Crude Oil Output Exceeds Last Year's by 81,000,000 Bbl.—Daily Production Now Over 1,750,000 Bbl.

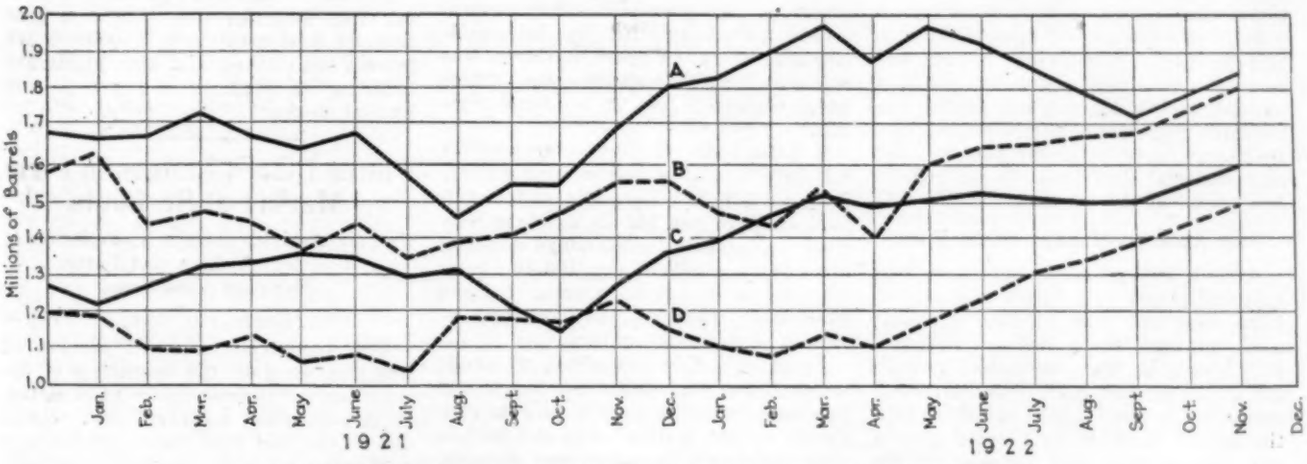
The year just closed has been a remarkable one for the oil industry. Crude oil production for 1922 probably exceeded 550,000,000 bbl.—a gain over 1921 of 17 per cent. Recently, for the first time in history the output of crude oil has reached 1,750,000 bbl. daily. The American Petroleum Institute has estimated that production for the week ended Jan. 6, 1923, averaged 1,752,000 bbl., as compared with 1,741,200 bbl. for the preceding week, an increase of 11,300 bbl.

The increase over last year, which has been explained largely by the declining production in Mexico, has come principally from Arkansas, California, Wyoming and Montana. A decrease in the central Texas field was more than offset by Oklahoma and California gains.

During the past few months the oil industry has witnessed an interesting race between domestic production and consumption. The recent demand for petroleum products has been equivalent to 1,700,000 bbl. per day. The supply has been amounting at times to over 1,900,000 bbl., the increment being due to imports from Mexico. The accumulation of stocks has brought the problem of oil storage to a very serious stage and during the coming year the industry will doubtless be forced to provide additional storage for crude oil.

THE MONTHLY AVERAGES

The statistics compiled by the United States Geological Survey are complete only for the first eleven months of the current year. During November the survey reports that the daily average production of petroleum (amounting to 1,596,300 barrels) increased 51,623 barrels; the daily average imports of crude and topped oil (amounting to 245,467 barrels) increased 6,499 barrels; the daily average exports of crude oil (amounting to 28,533 barrels) increased 4,630 barrels and the daily average consumption of crude petroleum (amounting to 1,781,433 barrels) increased 74,078 barrels, net results being that stocks increased 954,000 barrels. This is the smallest addition to storage that has been recorded for any month since September, 1920.



STATISTICS OF CRUDE PETROLEUM, JANUARY, 1921, TO DECEMBER, 1922

Daily Averages for—
(A) Domestic production of petroleum plus imports of "mineral crude oil."
(B) Consumption plus exports of domestic and imported petroleum.
(C) Domestic production (petroleum transported from producing properties).
(D) Consumption plus exports of domestic petroleum.

"Chem. & Met." Weighted Index of Chemical Prices

Base = 100 for 1913-14

This week	171.71
Last week	172.79
January, 1922	144
January, 1921	181
January, 1920	242
April, 1918 (high)	286
April, 1921 (low)	140

The slightly lower price for cottonseed oil was sufficient to lower this week's index by one full point. Prices for practically all of the other commodities were well maintained.

New Corporation to Sell German Potash

Kalisyndikat Representative Announces Plans for a New Distributive Agency for North America

A potash-importing corporation to market the products of the German syndicate in the United States, Canada, Cuba and Porto Rico has been announced by A. Vogel, the American representative of the Deutsches Kalisyndikat, G.m.b.H. It is generally believed that this represents the first move in an effort to transfer the syndicate's business to an agency in this country, in order to put it on a dollar basis. Difficulties in exchange, reparations and inland taxes in Germany no doubt helped to prompt this action. It is further intimated that the move may be a part of the syndicate's plans for recapturing its pre-war monopoly, since it would be entirely possible to allow large American consuming interests to participate in the importing corporation and share in its profits.

Mr. Vogel's announcement is as follows:

> I herewith beg to announce that the Deutsches Kalisyndikat, G.m.b.H., Berlin, has entered into an agreement with the Potash Importing Corporation, 42 Broadway, New York, whereby the corporation undertakes to market and distribute the syndicate's products in the United States of America, Canada, Cuba and Porto Rico.
>
> The contract begins with the first of May, 1923, and until then the syndicate will continue the sale and the distribution of its products, through its New York office, which after the first of May, 1923, will be liquidated.

New York Chemical and Allied Markets Are Only Moderately Active

Manufacturers of Salicylates Announce New Advances — Phenol and Derivatives at Higher Levels — Ammonium Nitrate Scarce and Firmer

ALTHOUGH PRICES for most basic commodities were firmly sustained, the chemical market during the past week lacked any outstanding interest. Activity was limited and buyers seemed inclined to purchase only small quantities for immediate consumption. It is possible that the present European trouble will eventually affect the market and some manufacturers were already sitting back to await any helpful changes. Export business to Europe has dropped off considerably, but South American and Far Eastern demand continued along fairly active lines. Producers of salicylic acid announced a new increase of 5c. per lb., because of higher producing costs. Phenol has shown some material gain during the past week and holders were not disposed to offer any round lots. Quotations were considerably higher on all phenol derivatives in sympathy with this product. Ammonium nitrate has become exceedingly scarce on the spot market and traders were asking abnormally high prices for limited stocks. Producers have not been able to offer any material and seem to be heavily sold ahead at the works.

The Arsenic Market Still Firm

Arsenic still remained very scarce on spot and prices were firmly maintained. Lead arsenate and calcium arsenate also retained their former strength. Formaldehyde was somewhat quieter due to the present high prices, although producers seemed quite satisfied with the recent business and stated that a new increase was very probable for the near future, due to the steadily increasing costs of production. Copper sulphate producers have been shipping in fair tonnages to South America, but are somewhat disappointed at the lack of interest from Europe. Domestic consumers have not shown any desire to purchase large stocks, in view of the fact that arsenic and its compounds are so extremely hard to locate. Amyl acetate, ethyl acetate and fusel oil are exceedingly firm and producers are not anxious to book any large tonnages at present levels. Imported caustic potash is materially higher for shipment and on spot. Caustic soda and soda ash continue along moderate lines, with domestic demand covering the lack of interest from exporters.

Principal Price Changes

Alcohol—The market continued along very steady lines and producers reported a well sold up condition at the works. Methanol 95 per cent in barrels is held at $1.21@1.23 per gal., with 97 per cent at $1.23@1.25 per gal. Denatured 188 proof No. 1 formula is moving in a fair way at 39@40c. per gallon.

Arsenic—Leading traders quote this market firm at 15½@16c. per lb. for limited stocks. Several large tonnages were reported on dock from Japan and Germany, but the increasing consuming demand seemed to overbalance these arrivals.

Ammonium nitrate—There has been extreme difficulty experienced in locating spot supplies. Here and there an odd lot was offered at 10@10½c. per lb. Producers are completely sold up at the works.

Amyl acetate—Producers report a steady demand and are finding it difficult to keep pace with deliveries. Supplies on spot are scarce with quotations ranging around $2.80@3 per gallon.

Copper sulphate—Producers report a fair business going into consuming channels, but also state that several orders were cancelled by insecticide manufacturers. Export business was reported fair to South America. Prices range around 6c. per lb. for large crystals.

Caustic soda—Export quotations for standard brands remain around $3.50@3.60 per 100 lb. Domestic material is held at $3.75 per 100 lb. ex-store New York. Contracts for standard material are offered at $2.50 per 100 lb., basis 60 per cent., f.o.b. works, carload quantities. Demand, in general, is merely of a routine nature.

Fusel oil—Spot supplies of crude material are very difficult to locate and producers report a heavily sold up condition at the works. The demand is very strong with quotations ranging around $2.30@2.40 per gal. for crude and $3.50@4.00 per gal. for refined.

Permanganate of potash—Several large sellers have advanced prices of U.S.P. to 16½c. per lb., but the general range is around 16@16½c. per lb. Demand continues fairly active.

Prussiate of potash—There has not been much activity shown in the yellow material of late and prices were held around 38c. per lb. Consumers were not anxious to purchase any round lots at the present high levels. Red prussiate was quoted much lower, with quotations around 85@90c. per pound.

Sal soda—Prices were practically unchanged among leading producers, with barrels ranging around $1.20 per 100 lb. and kegs at $1.35. Demand continues along moderate lines.

Soda ash—Several carload quantities were sold around $1.75 per 100 lb. in bags, on spot. Smaller lots were sold around $2.15@2.35 per 100 lb. Producers offer contracts at $1.20 per 100 lb., f.o.b. works, carload lots, basis 60 per cent, in bags.

Sulphuric acid—Contract business over 1923 is expected to reach very high levels. Withdrawals have already started and producers seem well satisfied with the trend. Spot business, however, is very dormant and quite irregular. Material in tank cars, 66 deg., is held at $14.50@15.00 per ton, with 60 deg. in tank cars at $9.00 a ton.

Coal-Tar Products

Benzene—Conditions in this market for the past few months are gradually improving. Prompt shipments are now available to an appreciable degree and sellers have begun to accept new business at 35@40c. per gal. for the pure and 26@30c. for the 90 per cent material. Resale material is still held at a slight premium.

Cresylic acid—The market continued in a very tight position with extreme difficulty experienced among purchasers to locate any nearby shipments. The dark 95 per cent material is quite scarce at 95c. per gal. in drums on spot. Several small sales of 97 per cent goods were recorded as high as $1.25@1.30 per gal. Holders of available material have much firmer ideas and the general tone tends to much higher levels.

Phenol—Prices are materially higher for this material due to the urgent demand from consumers. Producers are heavily sold ahead and spot goods are bringing as high as 36c. per lb. for limited stocks.

Fewer Price Changes in Firm Market at St. Louis

Greater Activity Awaits Completion of Inventory Taking and Better Shipping Conditions

St. Louis, Mo., Jan. 11, 1923.

The industrial chemical market of this district since the beginning of the year has not been as lively as expected. It is presumed, however, that this is due to the fact that trade generally is still occupied with inventory matters, but just as soon as this temporary influence has been removed the market will show more activity. Large consumers are showing a more liberal attitude in covering future requirements, which is evidence of better confidence in the market. Freight conditions are somewhat better, but are still below normal. The general tone of the market is very firm and price changes have been few and mostly in the upward direction.

Alkalis Show Strength

Business in alkalis has shown considerable strength since the first of the year and prices are very firm. Some contract business has been reported and a general feeling of confidence seems to exist among buyers. *Caustic soda* is being quoted at $3.90 for solid, $4.30 for flake, $4.50 for the ground per 100 lb. in 1- to 5-drum lots delivered to buyer's door. *Soda ash* is in good demand and quoted at $2.20 in 5-bag lots, and at $2.40 in 5-bbl. lots delivered buyer's door. *Sodium bicarbonate* is holding firm at $2.40 per 100 lb. in 5-bbl. lots, with a good volume of business being transacted. *Sal soda* has slumped some,

and quotations on barreled goods have been reported as low as $1.55 per 100 lb.

GENERAL AND SPECIAL CHEMICALS

The heavy *mineral acid* market is pretty good and fairly firm. Inquiry and demand for *citric acid* is nil and there is only a normal movement in *oxalic acid*. *Tartaric acid* and *cream of tartar* are in very light demand, but that is to be expected at this time of the year. An improvement has been noted in the inquiry and demand for *carbon bisulphide technical*, and some fairly good-sized orders have been placed. There has been no relief for the *white arsenic* situation, as American producers are reporting sold up for some time, and imports have been very small. The future does not seem very promising. Many of the large users have been obliged to curtail their operations because of lack of supplies of this article. The market for *glycerine* is in a rather unsettled condition. No reduction in price has yet appeared except in a few isolated cases where contracts were involved, but it seems to be common knowledge among buyers that glycerine is due for a drop and they are buying in limited quantities in anticipation of a decline. The copperas market has shown no change for some time and is still quoted at $1 in bulk and $1.25 in barrels, f.o.b. mills. There has been no material increase in the production, consequently there has been no accumulation of stocks, and the demand keeping pace with the output. The market has been very firm. *Potassium ferricyanide* and *ferrocyanide* have been moving in appreciable quantities. *Sulphur* is very quiet at present, the demand not being very strong. Prices, however, have not declined. *Zinc dust* is being quoted at 10c. in carload lots, f.o.b. New York, with a very firm market. Spelter has been stationary and a good business reported, which if continued will bring about higher prices. The *zinc sulphate* market has been quiet since our last report. However, it is firm at 3¼c. f.o.b. St. Louis in carload lots.

VEGETABLE OILS AND NAVAL STORES

Castor oil is very firm at 13½c. in drums, and a good volume of business is being transacted. *Linseed oil* is in a very firm condition and a rise in price is to be looked for. Shipping conditions, a desire on the part of flaxseed producers to hold seed for a better price and the fact that Argentine seed does not affect this market before March 15 at the earliest tend to make for a higher market. *Turpentine* is again on the upward trend and prices today are as follows: 5 bbl. lots, $1.48; single barrels, $1.54 per gal.

PAINT MATERIALS

The paint industry in this section is beginning to boom and orders are being placed that would indicate a prosperous season. There have been no price changes of note, though contracts for material are being placed in some instances for the year's requirements.

A Prediction for the Steel Market

Predictions are always more or less hazardous, but based upon what seems to be in the minds of buyers the prediction might be made that for the next three or four months there will be a very strong market for steel, with heavy deliveries and consumption, and that in the second half of the year there will be relatively light demand. This prediction leaves a leeway of two or three months as a twilight zone. The present showing may as a matter of fact be quite insufficient to base a prediction upon, but there is another factor deserving of consideration, the belief in many quarters that general business conditions, from the long range viewpoint, are hardly sufficient to sustain continuously a movement in steel measured by an ingot production at 40,000,000 tons a year, this being one-third greater than the output in either 1912 or 1913, the two largest tonnage years before the war, likewise one-third greater than the average of 1920, with its heavy output, and 1921, with its very light output. Production in 1922 was about 34,000,000 tons.

Steel Unusually Active Despite Lower Output

December Sales of Sheets More Than 150 Per Cent of Productive Capacity—Other Products Strong

PITTSBURGH, Jan. 12, 1923.

The 30 companies which make monthly returns of their steel ingot output report a production of 2,779,890 tons in December against 2,889,297 tons in November. The decrease is barely as much as the decrease in the number of working days from 26 to 25, while a little output was no doubt lost through the holiday season. Order books are in better shape than 30 days ago, labor supply is somewhat better than in October, simply on account of the curtailment in outdoor work, and pig iron and fuel supplies are sufficient for a heavier production.

Production of ingots by the steel industry as a whole was at a rate of about 40,000,000 tons a year in each of the last three months, there being no noticeable variation from month to month, and the prospect is that production will be somewhat heavier this month. The quarter as a whole may show a gain of 5 to 10 per cent over last quarter. No large increase could be expected, on account of labor supply, whatever the other factors in production might be.

All the finished steel markets are more or less active, the most sluggish item being structural shapes. In plates the activity is moderate except in car plates, which are booked far ahead.

SHEET MILLS DOUBLE THEIR SALES

The majority of independent steel producers had heavy bookings in December. Some of the independents entered December with decidedly lean order books, scarcely sufficient to carry some departments through the month, and these independents are now much better fixed. The independent sheet mills that report to the National Association of Sheet and Tin Plate Manufacturers, representing 66.5 per cent of the total capacity of the sheet industry, reported sales for December of 399,624 net tons, or 156.6 per cent of a month's capacity, almost double the business reported for any one of the preceding five months.

On the other hand, the United States Steel Corporation reported a December decrease in unfilled obligations of 94,539 tons, against a November decrease of 62,045 tons, and this despite the fact that its sheet and tin plate subsidiary opened its order books for the new period only on November 23, thus being a very light seller in November and a heavy seller in December.

Nearly all the independent wire mills have advanced their prices $2 a ton or more. The Steel Corporation seems unlikely to advance its prices on wire or other products. The greatly improved order books of independent sheet mills make relatively safe a prediction that the independent sheet mills will soon begin advancing their prices quite generally. The Wheeling pipe independent, previously one point above the general level, recently advanced another point. Nails are quotable at $2.70 to $2.80 and plain wire at 2.45c. to 2.70c.

Bars, shapes and plates are now very strong at the 2.00c. level, which was being shaded more or less in November. Hoops are 2.75c. to 2.90c., depending on gage, etc. Recently some attractive orders were booked at as low as 2.50c.

Billets, slabs and sheet bars are all quotable at $37.50 to $38.50, against a general level of $36.50 lately ruling, at which much first quarter contract tonnage was entered. There have been sales at both $37.50 and $38.50 in the past week. The $45 rod price has entirely disappeared, leaving the market at $47.50 for good orders and up to $50 for single carloads.

COKE AND PIG IRON

Connellsville coke has softened somewhat in the week, furnace coke being now easy at $8.50, with foundry at $9 to $9.25. The market is, however, much above the level existing when the sudden demand from the east for domestic coke effected a sharp advance. Furnaces seem to be well covered by contracts at $7.00 to $7.50. Production has been increasing, car supplies being materially better.

Pig iron has been dull as to actual turnover, but prices are stiffening. On small prompt lots of foundry iron valley furnaces are securing $28, furnace, against a general quotation of $27 a week ago, while first quarter contracts were made at $25 in the buying movement of about 30 days ago. Basic iron is not clearly defined. Recent transactions were at $24.25 and $24.50, valley, and since then there have been one or two sales on a basis of $25.50 or $26, but it remains to be seen whether such prices can be obtained generally. In some quarters the claim is made that basic iron cannot be bought at under $27. Bessemer remains at $27.50, with occasional small transactions.

Current Prices in the New York Market

FOR CHEMICALS, OILS AND ALLIED PRODUCTS

Although these prices are for the spot market in New York City, a special effort has been made to report the American manufacturer's quotations whenever available. In many instances these are for material f.o.b. works or on a contract basis and these prices are so designated. Quotations on imported and resale stocks are reported when of sufficient importance to have a material effect on the market. Prices quoted in these columns apply to large quantities in original packages.

General Chemicals

Acetic anhydride, 85%, drums	lb.	$0.39 –	$0.41
Acetone, drums	lb.	.21 –	.21½
Acid, acetic, 28%, bbl. 100	lb.	3.50 –	3.60
Acetic, 56%, bbl. 100	lb.	7.00 –	7.15
Glacial, 99½%, carboys. 100	lb.	12.80 –	13.25
Boric, crystals, bbl.	lb.	.11½–	.11¾
Boric, powder, bbl.	lb.	.11 –	.11½
Citric, kegs	lb.	.49 –	.50
Formic, 85%	lb.	.18 –	.19
Gallic, tech.	lb.	.45 –	.50
Hydrochloric, 18° tanks, 100	lb.	.80 –	1.00
Hydrofluoric, 52%, carboys	lb.	.11 –	.11½
Lactic, 44%, tech., light, bbl.	lb.	.11 –	.11½
22% tech., light, bbl.	lb.	.05 –	.05½
Muriatic, 20°, tanks, 100	lb.	1.00 –	1.10
Nitric, 36°, carboys	lb.	.04½–	.05
Nitric, 42°, carboys	lb.	.06 –	.06¼
Oleum, 20%, tanks	ton	17.00 –	18.00
Oxalic, crystals, bbl.	lb.	.13 –	.13½
Phosphoric, 50% carboys	lb.	.08½–	.09
Pyrogallic, resublimed	lb.	1.50 –	1.60
Sulphuric, 60°, tanks	ton	9.00 –	10.00
Sulphuric, 60°, drums	ton	12.00 –	14.00
Sulphuric, 66°, tanks	ton	14.50 –	15.00
Sulphuric, 66° drums	ton	19.00 –	20.00
Tannic, U.S.P., bbl.	lb.	.65 –	.70
Tannic, tech., bbl.	lb.	.40 –	.45
Tartaric, imp. crys., bbl.	lb.	.30½–	.31
Tartaric, imp., powd., bbl.	lb.	.31 –	.32
Tartaric, domestic, bbl.	lb.	–	.32
Tungstic, per lb. of WO	lb.	1.00 –	1.20
Alcohol, butyl, drums	gal.	.18 –	.23
Alcohol ethyl (Cologne spirit), bbl.	gal.	4.75 –	4.95
Alcohol, methyl (see Methanol)			
Alcohol, denatured, 188 proof No. 1	gal.	.39 –	.41
Alum, ammonia, lump, bbl.	lb.	.03½–	.03¾
Potash, lump, bbl.	lb.	.03½–	.03¾
Chrome, lump, potash, bbl.	lb.	.05 –	.05½
Aluminum sulphate, com., bags 100	lb.	1.50 –	1.65
Iron free bags	lb.	.02½–	.02¾
Aqua ammonia, 26°, drums	lb.	.06½–	.07¼
Ammonia, anhydrous, cyl.	lb.	.30 –	.30½
Ammonium carbonate, powd. casks	lb.	.09 –	.09½
Ammonium nitrate, tech., casks	lb.	.10 –	.11
Amyl acetate tech., drums	gal.	2.80 –	3.05
Arsenic, white, powd., bbl.	lb.	.15½–	.16
Arsenic, red, powd., kegs	lb.	.13½–	.14
Barium carbonate, bbl.	ton	75.00 –	77.00
Barium chloride, bbl.	ton	94.00 –	100.00
Barium dioxide, drums	lb.	.18 –	.18½
Barium nitrate, casks		.08½–	.08¾
Barium sulphate, bbl.	lb.	.04 –	.04½
Blanc fixe, dry, bbl.	lb.	.04 –	.04½
Blanc fixe, pulp, bbl.	ton	45.00 –	55.00
Bleaching powder, f.o.b. wks., drums 100	lb.	2.00 –	2.50
Resale drums 100	lb.	2.25 –	2.50
Borax, bbl.	lb.	.05½–	.05¾
Bromine, cases	lb.	.27 –	.28
Calcium acetate, bags 100	lb.	3.50 –	3.60
Calcium carbide, drums	lb.	.04½–	.04¾
Calcium chloride, fused, drums	ton	22.00 –	23.00
Gran. drums	lb.	.01½–	.01¾
Calcium phosphate, mono, bbl.	lb.	.06½–	.07
Camphor, cases	lb.	.93 –	.95
Carbon bisulphide, drums	lb.	.07 –	.07½
Carbon tetrachloride, drums	lb.	.10 –	.10½
Chalk, precip.—domestic, light, bbl.	lb.	.04½–	.04¾
Domestic, heavy, bbl.	lb.	.03½–	.03¾
Imported, light, bbl.	lb.	.04½–	.05
Chlorine, liquid, cylinders	lb.	.06 –	.06½
Chloroform, tech., drums	lb.	.35 –	.38
Cobalt oxide, bbl.	lb.	2.10 –	2.25
Copperas, bulk, f.o.b. wks.	ton	20.00 –	22.00
Copper carbonate, bbl.	lb.	.20 –	.20½
Copper cyanide, drums	lb.	.50 –	.55
Coppersulphate, crys., bbl. 100	lb.	6.00 –	6.25
Cream of tartar, bbl.	lb.	.25 –	.26
Dextrine, corn, bags 100	lb.	3.25 –	3.50
Epsom salt, dom., tech., bbl. 100	lb.	2.10 –	2.25
Epsom salt, imp., tech., bags 100	lb.	1.10 –	1.25
Epsom salt, U.S.P., dom., bbl. 100	lb.	2.50 –	2.75
Ether, U.S.P., drums	lb.	.13 –	.15
Ethyl acetate, com., 85%, drums	gal.	.80 –	.85
Ethyl acetate, pure (acetic ether, 98% to 100%)	gal.	.95 –	1.00
Formaldehyde, 40%, bbl.	lb.	.16 –	.16½
Fullers earth, f.o.b. mines	net ton	$16.00 –	$17.00
Fullers earth—imp., powd.,	net ton	30.00 –	32.00
Fusel oil, ref., drums	gal.	3.55 –	4.05
Fusel oil, crude, drums	gal.	2.30 –	2.40
Glaubers salt, wks., bags 100	lb.	1.20 –	1.40
Glaubers salt, imp., bags 100	lb.	1.00 –	1.25
Glycerine, c.p., drums extra	lb.	.18½–	.19
Glycerine, dynamite, drums	lb.	.17 –	.17½
Iodine, resublimed	lb.	4.50 –	4.60
Iron oxide, red, casks	lb.	.12 –	.18
Lead:			
White, basic cabonate, dry, casks	lb.	.08 –	.08¾
White, in oil, kegs	lb.	.10½–	.12
Red, dry, casks	lb.	.10½–	.10½
Red, in oil, kegs	lb.	.12 –	.14
Lead acetate, white crys., bbl.	lb.	.12 –	.12½
Lead arsenate, powd., bbl.	lb.	.21 –	.22
Lime-Hydrated, bbl.	per ton	16.80 –	17.00
Lime, Lump, bbl	280 lb.	3.63 –	3.65
Litharge, comm., casks	lb.	.09½–	.10
Lithophone, bbl.	lb.	.06½–	.07
Magnesium carb., tech., bags	lb.	.07 –	.07½
Methanol, 95%, bbl.	gal.	1.23 –	1.25
Methanol, 97%, bbl.	gal.	1.25 –	1.27
Nickel salt, double, bbl.	lb.	.10 –	.10½
Nickel salts, single, bbl.	lb.	.11 –	.11½
Phosgene		.60 –	.75
Phosphorus, red, cases	lb.	.35 –	.40
Phosphorus, yellow, cases	lb.	.30 –	.35
Potassium bichromate, casks	lb.	.10 –	.10½
Potassium bromide, gran., bbl.	lb.	.18 –	.23
Potassium carbonate, 80-85%, calcined, casks	lb.	.05½–	.05¾
Potassium chlorate, powd.	lb.	.07½–	.08
Potassium cyanide, drums	lb.	.47 –	.80
Potassium hydroxide (caustic potash) drums 100	lb.	6.75 –	7.00
Potassium iodide, cases	lb.	3.55 –	3.65
Potassium nitrate, bbl.	lb.	.06½–	.07
Potassium permanganate, drums	lb.	.16 –	.16¾
Potassium prussiate, red, casks	lb.	.85 –	.90
Potassium prussiate, yellow, casks	lb.	.38 –	.39
Salammoniac, white, gran., casks	lb.	.06½–	.06¾
Gray, gran., casks	lb.	.08 –	.08¼
Salsoda, bbl. 100	lb.	1.20 –	1.40
Salt cake (bulk)	ton	25.00 –	27.00
Soda ash, light, 58% flat, bags, contract 100	lb.	1.60 –	1.67
Soda ash, light, basis, 48%, bags, contract, f.o.b. wks. 100	lb.	1.20 –	1.30
Soda ash, light, 58%, flat, bags, resale 100	lb.	1.75 –	1.80
Soda ash, dense, bags, contract, basis 48% 100	lb.	1.17½–	1.20
Soda ash, dense, in bags, resale 100	lb.	1.85 –	1.90
Soda, caustic, 76%, solid, drums, f.a.s. 100	lb.	3.50 –	3.75
Soda, caustic, 76%, solid, drums, contract 100	lb.	3.35	3.40
Soda, caustic, basis 60% wks., contract 100	lb.	2.50 –	2.60
Soda, caustic, ground and flake, contracts 100	lb.	3.80 –	3.90
Soda, caustic, ground and flake, resale 100	lb.	4.00 –	4.15
Sodium acetate, works, bags	lb.	.06½–	.07
Sodium bicarbonate, bbl. 100	lb.	1.75 –	1.85
Sodium bichromate, casks	lb.	.07½–	.08
Sodium bisulphate (niter cake)	ton	6.00 –	7.00
Sodium bisulphite, powd., U.S.P., bbl.	lb.	.04½–	.04¾
Sodium chlorate, kegs	lb.	.06½–	.07
Sodium chloride long ton		12.00 –	13.00
Sodium cyanide, cases	lb.	.19 –	.23
Sodium fluoride, bbl.	lb.	.09½–	.09¾
Sodium hyposulphite, bbl.	lb.	.03 –	.03½
Sodium nitrite, casks	lb.	.08½–	.09
Sodium peroxide, powd., cases	lb.	.28 –	.30
Sodium phosphate, dibasic, bbl.	lb.	.03½–	.04
Sodium prussiate, yel. drums	lb.	.18½–	.20
Sodium silicate (40°, drums) 100	lb.	.80 –	1.15
Sodium silicate (60°, drums) 100	lb.	2.25 –	2.40
Sodium sulphide, fused, 60-62% drums	lb.	.04½–	.04¾
Sodium sulphite, crys., bbl.	lb.	.03½–	.03¾
Strontium nitrate, powd., bbl.	lb.	.09½–	.10¼
Sulphur chloride, yel drums	lb.	.04½–	.05
Sulphur, crude	ton	18.00 –	20.00½
Sulphur dioxide, liquid, cyl.	lb.	.08 –	.08
Sulphur, flour, bbl. 100	lb.	2.50 –	3.15
Sulphur, roll, bbl. 100	lb.	2.15 –	2.20
Talc—imported, bags	ton	$30.00 –	$40.00
Talc—domestic powd., bags	ton	18.00 –	25.00
Tin bichloride, bbl.	lb.	.11 –	.11½
Tin oxide, bbl.	lb.	.45 –	.47
Zinc carbonate, bags	lb.	.14 –	.14½
Zinc chloride, gran, bbl.	lb.	.07 –	.07½
Zinc cyanide, drums	lb.	.42 –	.44
Zinc oxide, XX, bbl.	lb.	.07½–	.08
Zinc sulphate, bbl. 100	lb.	2.75 –	3.00

Coal-Tar Products

Alpha-naphthol, crude, bbl.	lb.	$ .95 –	$1.00
Alpha-naphthol, ref., bbl.	lb.	1.05 –	1.10
Alpha-naphthylamine, bbl.	lb.	.28 –	.30
Aniline oil, drums	lb.	.16½–	.17
Aniline salts, bbl.	lb.	.24 –	.25
Anthracene, 80%, drums	lb.	.75 –	1.00
Anthracene, 80%, imp., drums, duty paid	lb.	.65 –	.70
Anthraquinone, 25%, paste, drums	lb.	.70 –	.75
Benzaldehyde U.S.P., carboys	lb.	1.35 –	1.40
Benzene, pure, water-white, tanks and drums	gal.	.35 –	.40
Benzene, 90%, drums	gal.	.26 –	.32
Benzene, 90%, drums, resale	gal.	.34 –	.35
Benzidine base, bbl.	lb.	.85 –	.90
Benzidine sulphate, bbl.	lb.	.75 –	.80
Benzoic acid, U.S.P., kegs	lb.	.72 –	.75
Benzoate of soda, U.S.P., bbl.	lb.	.57 –	.65
Benzyl chloride, 95-97%, ref., drums	lb.	.25 –	.27
Benzyl chloride, tech., drums	lb.	.20 –	.23
Beta-naphthol, subl., bbl.	lb.	.55 –	.60
Beta-naphthol, tech., bbl.	lb.	.25 –	.26
Beta-naphthylamine, tech.	lb.	1.00 –	1.25
Carbazol, bbl.	lb.	.75 –	.90
Cresol, U.S.P., drums	lb.	.14 –	.20
Ortho-cresol, drums	lb.	.18 –	.22
Cresylic acid, 97%, resale, drums	gal.	1.25 –	1.30
95-97%, drums, resale	gal.	.95 –	1.00
Dichlorbenzene, drums	lb.	.07 –	.09
Diethylaniline, drums	lb.	.50 –	.60
Dimethylaniline, drums	lb.	.39 –	.41
Dinitrobenzene, bbl.	lb.	.20 –	.22
Dinitroclorbenzene, bbl.	lb.	.22 –	.23
Dinitronaphthalene, bbl.	lb.	.30 –	.32
Dinitrophenol, bbl.	lb.	.35 –	.40
Dinitrotoluene, bbl.	lb.	.22 –	.24
Dip oil, 25%, drums	gal.	.25 –	.30
Diphenylamine, bbl.	lb.	.54 –	.56
H-acid, bbl.	lb.	.75 –	.80
Meta-phenylenediamine, bbl.	lb.	.95 –	1.00
Michlers ketone, bbl.	lb.	3.50 –	3.75
Monochlorbenzene, drums	lb.	.08 –	.10
Monoethylaniline, drums	lb.	.95 –	1.10
Naphthalene, crushed, bbl.	lb.	.05½–	.06
Naphthalene, flake, bbl.	lb.	.06 –	.06½
Naphthalene, balls, bbl.	lb.	.07 –	.07½
Naphthionate of soda, bbl.	lb.	.58 –	.65
Naphthionic acid, crude, bbl.	lb.	.60 –	.65
Nitrobenzene, drums	lb.	.10 –	.12
Nitro-naphthalene, bbl.	lb.	.30 –	.35
Nitro-toluene, drums	lb.	.15 –	.17
N-W acid, bbl.	lb.	1.20 –	1.30
Ortho-amidophenol, kegs	lb.	2.30 –	2.35
Ortho-dichlorbenzene, drums	lb.	.17 –	.20
Ortho-nitrophenol, bbl.	lb.	.90 –	.92
Ortho-nitrotoluene, drums	lb.	.12½–	.14
Ortho-toluidine, bbl.	lb.	.14 –	.16
Para-amidophenol, base, kegs	lb.	1.25 –	1.30
Para-amidophenol, HCl, kegs	lb.	1.30 –	1.35
Para-dichlorbenzene, bbl.	lb.	.17 –	.20
Paranitraniline, bbl.	lb.	.75 –	.80
Para-nitrotoluene, bbl.	lb.	.55 –	.65
Para-phenylenediamine, bbl.	lb.	1.50 –	1.55
Para-toluidine, bbl.	lb.	.85 –	.90
Phthalic anhydride, bbl.	lb.	.35 –	.38
Phenol, U.S.P., drums	lb.	.35 –	.37
Picric acid, bbl.	lb.	.20 –	.22
Pyridine, dom., drums	gal.	nominal	
Pyridine, imp., drums	gal.	2.80 –	3.00
Resorcinol, tech., kegs	lb.	1.50 –	1.55
Resorcinol, pure, kegs	lb.	2.00 –	2.10
R-salt, bbl.	lb.	.55 –	.60
Salicylic acid, tech., bbl.	lb.	.40 –	.42
Salicylic acid, U.S.P., bbl.	lb.	.45 –	.47
Solvent naphtha, water-white, drums	gal.	.37 –	.40
Crude, drums	gal.	.22 –	.24
Sulphanilic acid, crude, bbl.	lb.	.20 –	.22
Thiocarbanilide, kegs	lb.	.35 –	.38
Toluidine, kegs	lb.	1.20 –	1.30
Toluidine, mixed, kegs	lb.	.30 –	.35
Toluene, tank cars	gal.	.35 –	.37
Toluene, drums	gal.	.40 –	.43
Xylidines drums	lb.	.40 –	.45
Xylene, pure, drums	gal.	.45 –	.50
Xylene, com., drums	gal.	.40 –	.42
Xylene, com., tanks	gal.	.30 –	

Naval Stores

Rosin B-D, bbl.	280 lb.	$6.15 –	
Rosin E-I, bbl.	280 lb.	6.30 –	
Rosin K-N, bbl.	280 lb.	6.50 –	$6.75
Rosin W.G.-W.W., bbl.	280 lb.	7.75 –	8.25
Wood rosin, bbl.	280 lb.	6.25 –	
Turpentine, spirits of, bbl.	gal.	1.51 –	1.52
Wood, steam dist., bbl.	gal.	1.35 –	
Wood, dest. dist., bbl.	gal.	1.25 –	
Pine tar pitch, bbl.	200 lb.	–	6.00
Tar, kiln burned, bbl.	500 lb.	–	12.50
Retort tar, bbl.	500 lb.	–	11.00
Rosin oil, first run, bbl.	gal.	.43 –	
Rosin oil, second run, bbl.	gal.	.47 –	
Rosin oil, third run, bbl.	gal.	.53 –	
Pine oil, steam dist.	gal.	–	.90
Pine oil, pure, dest. dist.	gal.	–	.85
Pine tar oil, ref.	gal.	–	.46
Pine tar oil, crude, tanks f.o.b. Jacksonville, Fla.	gal.	–	.35
Pine tar oil, double ref., bbl.	gal.	–	.75
Pine tar, ref., thin, bbl.	gal.	–	.25
Pinewood creosote, ref., bbl.	gal.	–	.52

Vegetable Oils

Castor oil, No. 3, bbl.	lb.	$.11½ –	$.12
Castor oil, AA, bbl.	lb.	.12½ –	.12¾
Chinawood oil, bbl.	lb.	.15 –	.15½
Coconut oil, Ceylon, bbl.	lb.	.09⅜ –	.09½
Coconut oil, Cochin, bbl.	lb.	.09½ –	.09
Corn oil, crude, bbl.	lb.	.11 –	.11¼
Cottonseed oil, crude (f.o.b. mill), tanks	lb.	.09½ –	
Summer yellow, bbl.	lb.	.11½ –	.11¾
Winter yellow, bbl.	lb.	.11½ –	.12
Linseed oil, raw, car lots, bbl.	gal.	.87 –	.88
Raw, tank cars (dom.)	gal.	.84 –	.85
Boiled, 5-bbl. lots (dom.)	gal.	.89 –	.90
Olive oil, denatured, bbl.	gal.	1.05 –	1.12
Palm, Lagos, casks	lb.	.08 –	.08½
Palm kernel, bbl.	lb.	.08¾ –	.09
Peanut oil, crude, tanks (mill)	lb.	.12½ –	.13
Peanut oil, refined, bbl.	lb.	.15½ –	.16
Rapeseed oil, refined, bbl.	gal.	.83 –	.84
Rapeseed oil, blown, bbl.	gal.	.87 –	.88
Soya bean (Manchurian), bbl.	lb.	.11½ –	
Tank, f.o.b. Pacific coast	lb.	.09½ –	.09¾

Fish Oils

Menhaden, light pressed, bbl.	gal.	$0.60 –	
White bleached, bbl.	gal.	.64 –	.65
Blown, bbl.	gal.	.68 –	.69
Whale No. 1 crude, tanks, coast	lb.	.06 –	.06½

Dye & Tanning Materials

Divi-divi, bags	ton	$38.00 –	$39.00
Fustic, sticks	ton	30.00 –	35.00
Fustic, chips, bags	lb.	.04 –	.05
Logwood, sticks	ton	28.00 –	30.00
Logwood, chips, bags	lb.	.02½ –	.03½
Sumac, leaves, Sicily, bags	ton	65.00 –	
Sumac, ground, bags	ton	55.00 –	60.00
Sumac, domestic, bags	ton	35.00 –	
Tapioca flour, bags	lb.	.03¼ –	.05

EXTRACTS

Archil, conc., bbl.	lb.	$0.18 –	$0.20
Chestnut, 25% tannin, tanks	lb.	.02 –	.03
Divi-divi, 25% tannin, bbl.	lb.	.04 –	.05
Fustic, crystals, bbl.	lb.	.20 –	.22
Fustic, liquid, 42°, bbl.	lb.	.08 –	.09
Gambier, liq., 25% tannin, bbl.	lb.	.08 –	.09
Hematine crys., bbl.	lb.	.14 –	.18
Hemlock, 25% tannin, bbl.	lb.	.04 –	.05
Hypernic, solid, drums	lb.	.24 –	.26
Hypernic, liquid, 51°, bbl.	lb.	.14 –	.17
Logwood, crys., bbl.	lb.	.19 –	.20
Logwood, liq., 51°, bbl.	lb.	.09 –	.10
Quebracho, solid, 65% tannin, bbl.	lb.	.04½ –	.05
Sumac, dom., 51°, bbl.	lb.	.06½ –	.07

Waxes

Bayberry, bbl.	lb.	$0.30 –	$0.31
Beeswax, refined, dark, bags	lb.	.30 –	.32
Beeswax, refined, light, bags	lb.	.34 –	.35
Beeswax, pure white, cases	lb.	.40 –	.41
Candellila, bags	lb.	.34 –	.35
Carnauba, No. 1, bags	lb.	.38 –	.40
No. 2, North Country, bags	lb.	.23 –	.24
No. 3, North Country, bags	lb.	.17 –	.17½
Japan, cases	lb.	.15 –	.15½
Montan, crude, bags	lb.	.03½ –	.04
Paraffine, crude, match, 105-110 m.p.	lb.	.04 –	.04½
Crude, scale 124-126 m.p., bags	lb.	.02½ –	.02¾
Ref., 118-120 m.p., bags	lb.	.03½ –	.03¾
Ref., 125 m.p., bags	lb.	.03¾ –	.03¾
Ref, 128-130 m.p., bags	lb.	.04 –	.04¼
Ref., 133-135 m.p., bags	lb.	.04¼ –	.04¾
Ref., 135-137 m.p., bags	lb.	.05 –	.05¼
Stearic acid, agle pressed, bags	lb.	.10 –	.10½
Double pressed, bags	lb.	.10½ –	.10¾
Triple pressed, bags	lb.	.11 –	.11½

Fertilizers

Ammonium sulphate, bulk, f.o.b. works	100 lb.	$3.20 –	$3.25
F.a.s. double bags	100 lb.	3.60 –	3.75
Blood, dried, bulk	unit	4.60 –	
Bone, raw, 3 and 50, ground	ton	30.00 –	35.00
Fish scrap, dom., dried, wks.	unit	5.00 –	5.10
Nitrate of soda, bags	100 lb.	2.60 –	2.65
Tankage, high grade, f.o.b. Chicago	unit	4.60 –	4.65
Phosphate rock, f.o.b. mines, Florida pebble, 68-72%	ton	$3.50 –	$4.00
Tennessee, 78-80%	ton	7.00 –	8.00
Potassium muriate, 80%, bags	ton	35.55 –	38.25
Potassium sulphate, bags	unit	1.00 –	

Crude Rubber

Para—Upriver fine	lb.	$0.26½ –	$0.26¾
Upriver coarse	lb.	.19 –	.19½
Upriver caucho ball	lb.	.21 –	.21½
Plantation—First latex crepe	lb.	.30½ –	.31
Ribbed smoked sheets	lb.	.30½ –	.31
Brown crepe, thin, clean	lb.	.23 –	.23¼
Amber crepe No. 1	lb.	.23 –	.23¼

Miscellaneous Materials

Asbestos, crude No. 1, f.o.b., Quebec	sh. ton	$450.00 –	$550.00
Asbestos, shingle, f.o.b., Quebec	sh. ton	60.00 –	80.00
Asbestos, cement, f.o.b., Quebec	sh. ton	15.00 –	17.00
Barytes, grd., white, f.o.b. mills, bbl.	net ton	16.00 –	20.00
Barytes, grd., off-color, f.o.b. mills bulk	net ton	13.00 –	21.00
Barytes, floated, f.o.b. St. Louis, bbl.	net ton	24.00 –	28.00
Barytes, crude f.o.b. mines, bulk	net ton	8.00 –	9.00
Casein, bbl., tech.	lb.	.12 –	.14
China clay (kaolin) crude, f.o.b. Ga.	net ton	7.00 –	9.00
Washed, f.o.b. Ga.	net ton	8.00 –	9.00
Powd., f.o.b. Ga.	net ton	14.00 –	20.00
Crude f.o.b. Va.	net ton	8.00 –	12.00
Ground, f.o.b. Va.	net ton	13.00 –	20.00
Imp., lump, bulk	net ton	14.00 –	20.00
Imp., powd.	net ton	40.00 –	45.00
Feldspar, No. 1 pottery	long ton	6.00 –	7.00
No. 2 pottery	long ton	5.00 –	5.50
No. 1 soap	long ton	7.00 –	7.50
No. 1 Canadian, f.o.b. mill	long ton	20.00 –	21.00
Graphite, Ceylon, lump, first quality, bbl.	lb.	.05 –	.05½
Ceylon, chip, bbl.	lb.	.04 –	.04½
High grade amorphous crude	ton	35.00 –	50.00
Gum arabic, amber, sorts, bags	lb.	.15 –	.16
Gum tragacanth, sorts, bags	lb.	.50 –	.60
No. 1, bags	lb.	1.75 –	1.80
Kieselguhr, f.o.b. Cal.	ton	40.00 –	42.00
F.o.b. N. Y.	ton	50.00 –	55.00
Magnesite, crude, f.o.b. Cal.	ton	14.00 –	15.00
Pumice stone, imp., casks	lb.	.03 –	.05½
Dom., lump, bbl.	lb.	.05 –	.05½
Dom., ground, bbl.	lb.	.06 –	.07
Shellac, orange fine, bags	lb.	.76 –	.77
Orange superfine, bags	lb.	.78 –	.79
A. C. garnet, bags	lb.	.77 –	.78
T. N., bags	lb.	.74 –	.75
Silica, glass sand, f.o.b. Ind.	ton	2.00 –	2.50
Silica, sand blast, f.o.b. Ind.	ton	2.50 –	5.00
Silica, amorphous, 250-mesh, f.o.b. Ill.	ton	17.00 –	17.50
Silica, bldg. sand, f.o.b. Pa.	ton	2.00 –	2.75
Soapstone, coarse, f.o.b. Vt., bags	ton	7.00 –	8.00
Talc, 200 mesh, f.o.b., Vt., bags	ton	6.50 –	9.00
Talc, 200 mesh, f.o.b. Ga., bags	ton	7.00 –	9.00
Talc, 200 mesh, f.o.b. Los Angeles, bags	ton	16.00 –	20.00

Refractories

Bauxite brick, 56% Al_2O_3, f.o.b. Pittsburgh	ton	$45–50
Chrome brick, f.o.b. Eastern shipping points	ton	50–52
Chrome cement, 40-50% Cr_2O_3	ton	23–27
40-45% Cr_2O_3, sacks, f.o.b. Eastern shipping points	ton	23.00
Fireclay brick, 1st. quality, 9-in. shapes, f.o.b. Ky. wks.	1,000	40–46
2nd. quality, 9-in. shapes, f.o.b. wks.	1,000	36–41
Magnesite brick, 9-in. straight (f.o.b. wks.)	ton	65–68
9-in. arches, wedges and keys	ton	80–85
Scraps and splits	ton	85
Silica brick, 9-in. sizes, f.o.b. Chicago district	1,000	48–50
Silica brick, 9-in. sizes, f.o.b. Birmingham district	1,000	48–50
F.o.b. Mt. Union, Pa.	1,000	42–44
Silicon carbide refract. brick, 9-in.	1,000	1,100.00

Ferro-Alloys

Ferrotitanium, 15-18% f.o.b. Niagara Falls, N. Y.	ton	$200.00 –	$225.00
Ferrochromium, per lb. of Cr, 6-8% C	lb.	.11 –	.11½
4-6% C	lb.	.11½ –	.12
Ferromanganese, 78-82% Mn, Atlantic seabd. duty paid	gr. ton	100.00 –	105.00
Spiegeleisen, 19-21% Mn.	gr. ton	35.00 –	37.00
Ferromolybdenum, 50-60% Mo, per lb. Mo	lb.	1.90 –	2.15
Ferrosilicon, 10-15%	gr. ton	40.00 –	45.00
50%	gr. ton	75.00 –	80.00
75%	gr. ton	115.00 –	120.00
Ferrotungsten, 70-80%, per lb. of W	lb.	$0.90 –	$0.95
Ferro-uranium, 35-50% of U, per lb. of U	lb.	6.00 –	
Ferrovanadium, 30-40%, per lb. of V	lb.	3.50 –	4.00

Ores and Semi-finished Products

Bauxite, dom. crushed, dried, f.o.b. shipping points	ton	$6.00 –	$9.00
Chrome ore, Calif. concentrates, 50% min. Cr_2O_3	ton	22.00 –	23.00
C.i.f. Atlantic seaboard	ton	18.50 –	19.00
Coke, fdry., f.o.b. ovens	ton	9.00 –	9.50
Coke, furnace, f.o.b. ovens	ton	9.00 –	9.50
Fluorspar, gravel, f.o.b. mines, New Mexico	ton	17.50 –	
Fluorspar, No. 2 Lump — Ky. & Ill. mines	ton	25.00 –	
Ilmenite, 52% TiO_2	lb.	.01¼ –	.01½
Manganese ore, 50% Mn, c.i.f. Atlantic seaport	unit	.45 –	
Manganese ore, chemical (MnO_2)	ton	75.00 –	80.00
Molybdenite, 85% MoS_2, per lb. MoS_2, N. Y.	lb.	.80 –	.85
Monazite, per unit of ThO_2, c.i.f., Atl. seaport	lb.	.06 –	.08
Pyrites, Span., fines, c.i.f. Atl. seaport	unit	.11½ –	.12
Pyrites, Span., furnace size, c.i.f. Atl. seaport	unit	.11½ –	.12
Pyrites, dom. fines, f.o.b. mines, Ga.	unit	Nominal	
Rutile, 95% TiO_2	lb.	.12 –	
Tungsten, scheelite, 60% WO_3 and over, per unit WO_3	unit	8.00 –	8.50
Tungsten, wolframite, 60% WO_3 and over, per unit WO_3	unit	7.50 –	8.00
Uranium ore (carnotite) per lb. of U_3O_8	lb.	3.50 –	3.75
Uranium oxide, 96% per lb. U_3O_8	lb.	2.25 –	2.50
Vanadium pentoxide, 99%	lb.	12.00 –	14.00
Vanadium ore, per lb. V_2O_5	lb.	1.00 –	
Zircon, washed, iron free, f.o.b. Pablo, Fla.	lb.	.04½ –	.13

Non-Ferrous Materials

	Cents per Lb.
Copper, electrolytic	14.75
Aluminum, 98 to 99%	22.00–23.00
Antimony, wholesale, Chinese and Japanese	6.60
Nickel, ordinary (ingot)	36.00
Nickel, electrolytic	39.00
Nickel, electrolytic, resale	32.00–33.00
Nickel, ingot and shot, resale	36.00
Monel metal, shot and blocks	32.00
Monel metal, ingots	35.00
Monel metal, sheet bars	38.00
Tin, 5-ton lots, Straits	38.75
Lead, New York, spot	7.50
Lead, E. St. Louis, spot	7.30
Zinc, spot, New York	7.15–7.25
Zinc, spot, E. St. Louis	6.80–6.90

OTHER METALS

Silver (commercial)	oz.	$0.64½
Cadmium	lb.	1.15
Bismuth (500 lb. lots)	lb.	2.45
Cobalt	lb.	3.00@3.25
Magnesium, ingots, 99%	lb.	1.00@1.05
Platinum	oz.	118.00
Iridium	oz.	250.00@275.00
Palladium	oz.	65.00@ 70.00
Mercury	75 lb.	74.00

FINISHED METAL PRODUCTS

	Warehouse Price Cents per Lb.
Copper sheets, hot rolled	20.00
Copper bottoms	30.00
Copper rods	19.75
High brass wire	18.75
High brass rods	16.75
Low brass wire	19.60
Low brass rods	20.25
Brazed brass tubing	23.00
Brazed bronze tubing	28.00
Seamless copper tubing	24.75
Seamless high brass tubing	22.00

OLD METALS—The following are the dealers' purchasing prices in cents per pound:

Copper, heavy and crucible	11.00@11.25
Copper, heavy and wire	10.50@10.75
Copper, light and bottoms	8.50@ 8.75
Lead, heavy	4.50@ 4.75
Lead, tea	3.25@ 3.50
Brass, heavy	5.50@ 5.75
Brass, light	5.00@ 5.25
No. 1 yellow brass turnings	5.50@ 5.75
Zinc	2.25@ 2.50

Structural Material

The following base prices per 100 lb. are for structural shapes 3 in. by ¼ in. and larger, and plates ¼ in. and heavier, from jobbers' warehouses in the cities named:

	New York	Chicago
Structural shapes	$2.90	$2.90
Soft steel bars	2.80	2.80
Soft steel bar shapes	2.80	2.80
Soft steel bands	3.40	3.40
Plates ¼ to 1 in. thick	2.90	2.90

Industrial

Financial, Construction and Manufacturers' News

Construction and Operation

Alabama

EMPIRE—The Empire Coal Co., Birmingham, has plans nearing completion for the construction of a byproduct coke plant at its properties near Empire, to consist of an initial battery of 40 ovens and auxiliary equipment. The project is estimated to cost close to $1,000,000.

TARRANT CITY—The National Cast Iron Pipe Co. has broken ground for the erection of a large addition at its local foundry, and will also make a number of improvements in the present works. The De Lavaud process of cast iron pipe production will be installed in the new plant. A fund of more than $200,000 has been arranged for the expansion.

Arkansas

CAMDEN—The Texas Co., Dallas, Tex., has commenced the construction of a new oil storage and distributing plant at Louann, near Camden, with initial installation to comprise twenty-five 55,000 bbl. tanks and auxiliary equipment.

SMACKOVER — The Pan-American Petroleum & Transport Co., 120 Broadway, New York, has acquired a tract of local property, consisting of about 165 acres, and plans for extensive development. Plans are under way for a storage and distributing plant of twenty-two 66,000 bbl. tanks and auxiliary apparatus. Edward L. Doheny is president.

PEARSON—The Lion Oil & Refining Co., Kansas City, Mo., will soon commence work on a local oil plant to consist of six 1,000 bbl. stills, 9 steel tanks and other operating equipment. It will cost in excess of $75,000.

California

FRESNO — The California Products Co., Butler and O Sts., Robert Hulme, head, has preliminary plans under consideration for the establishment of a local plant for the manufacture of industrial alcohol and kindred specialties.

LOS ANGELES — The Minarock Products Co. is completing plans for the installation of a new crushing and screening plant, for the production of special rock and mineral products, to include complete rock crusher, grade screens, storage bins and conveying equipment. A. Godfrey Bailey, Jr., 410 Orpheum Bldg., is architect.

Connecticut

NORWICH — The Uncas Paperboard Co., recently organized with a capital of $1,500,000, is planning for early operations at the local plant of the Ironsides Board Corp., recently acquired at a receiver's sale by James E. Smith of the Chesapeake Paper Board Co., Woodall St., Baltimore, Md., and who will head the new organization. It is purposed to remodel a number of buildings at the mill, and install additional equipment. Others interested in the new company are Frank W. Browning and Joseph H. Eilers, both of Montville, Conn.

Georgia

ATHENS — The George Brick Co. has arranged a list of equipment for installation at its new local plant, to replace the works recently destroyed by fire and will commence rebuilding at an early date. It is proposed to develop a capacity of 30,000 bricks per day. H. H. Hinton and R. C. Wilson head the company.

SAVANNAH—The Georgia-Florida Fertilizer Co. has perfected plans for immediate operations at the former plant of the Kirkland Fertilizer Co., near Savannah, recently acquired. A number of improvements will be made for increased production.

Illinois

TAYLORVILLE — The Hopper Paper Co., recently organized, has revised plans under way for the construction of its proposed new mill, to be 2-story and basement, 80x165 ft., estimated to cost approximately $75,000. B. Hopper, president of the Kalamazoo Sanitary Mfg. Co., Kalamazoo, Mich., heads the new organization. Billingham & Cobb, Press Bldg., Kalamazoo, are architects.

Indiana

SEYMOUR—The Silverstone Stucco & Plaster Products Co., 3323 Park Ave., Indianapolis, John R. Briggs, president, recently incorporated, is planning for the construction of a new local plant for the manufacture of stucco, under a new process, plaster and lime products, etc. It is estimated to cost about $100,000, including machinery.

Kansas

BONNER SPRINGS—The International Cement Corp., 342 Madison Ave., New York, has acquired the local plant of the Bonner Portland Cement Co., for a consideration said to be about $600,000. Plans are in progress for extensions in the present works, including the installation of considerable new equipment for increased manufacture. It is expected to develop a maximum output of close to 600,000 bbl. per annum. Holger Struckman is president.

Kentucky

LAWTON—The Enterprise Chemical Co., P. O. Box 545, Huntington, W. Va., recently formed with a capital of $100,000, has plans under way for the erection of a local plant for the manufacture of lime products, to include crushing, pulverizing, screening and other operating departments. A hydrating plant is also contemplated. It is expected to develop an output of 1,500 tons per day. F. L. Parr is general manager, and William Lewis, construction engineer.

Maryland

BALTIMORE—The United States Industrial Alcohol Co., 27 William St., New York, is contemplating plans and will take bids in the near future for the erection of a new 1-story addition to its local plant in the Curtis Bay district, 60x180 ft. Samuel Moore is company engineer.

BALTIMORE — The Board of Directors, Johns Hopkins University, has plans nearing completion for the erection of a new chemical laboratory at the institution, estimated to cost approximately $600,000, with equipment. It is expected that bids will be called for at an early date. Edward L. Palmer, Jr., 513 North Charles St., is architect.

HAVRE DE GRACE — William E. Veasey, Havre de Grace, is perfecting plans for the organization of a company to construct and operate a local plant for the manufacture of brick, tile and other burned clay products. A list of equipment to be installed will soon be prepared.

BALTIMORE—Fire, Jan. 5, destroyed the plant of the Commercial Envelope Co., 2400 Frederick Ave., manufacture of paper products, with loss approximating $50,000, including equipment. It is expected that the plant will be rebuilt. Howard Jones heads the company.

Massachusetts

BOSTON—Henry Gibbons, 12-20 Glenwood Ave. has filed plans for the erection of a new 1-story foundry.

CLINTON — The Clinton Gas Light Co., Pleasant St., has plans under way for the construction of a 2-story addition to its artificial gas plant on Parker St., to cost about $125,000. W. W. Russell, 77 Franklin St., Boston, is engineer.

Michigan

MONROE—The River Raisin Paper Co. has tentative plans under consideration for the erection of a 1-story addition to its plant, to be used primarily for the manufacture of box-board and other carboard products. G. H. Wood is president.

IRON MOUNTAIN—The Ford Motor Co., Highland Park, is considering plans for the construction of a new local plant for the manufacture of chemical products including wood alcohol, acetate of lime and other byproducts. The size and estimated cost are being determined.

LUDINGTON — The Marine Rubber Corp., recently organized under Delaware laws with capital of $1,250,000, will succeed the Ludington Rubber Co., taking over and operating a local plant for the manufacture of a line of rubber products for marine and other service. Extensions and improvements are planned. A. H. Gruber is president, and Andrew W. Newberg, vice-president.

Nevada

TONOPAH — The Tonopah Extension Co. has plans in progress for extensions in its local mill, including the installation of additional equipment to increase the output from 415 to 500 tons per day.

New Jersey

NEWARK — The Armitage Varnish Co., 189-215 South St., has perfected plans for the immediate erection of a 3-story plant, 48x50 ft., estimated to cost about $25,000.

RIDGEFIELD PARK—The Bogota Folding Box Co., Bogota, N. J., has acquired the plant of the British-American Chemical Co., Ridgefield Park, consisting of a number of buildings totaling 55,000 sq.ft., on a 7-acre tract of land, for a consideration of $80,000. The selling company, represented by a receiver, is now defunct. The purchaser is said to be planning to use the property for a new plant. Herman M. Hess and Michael Densen head the company.

New York

BROOKLYN — Gerstendorfer Brothers, 231 East 42d St., New York, manufacturers of bronze powders, etc., are having plans completed for the erection of a new 7-story plant at Clinton and Bush Sts., estimated to cost $350,000. Russell G. Cory, 30 Church St., New York, is consulting engineer.

LONG ISLAND CITY—The Oscar Schlegel Mfg. Co., 124 East 13th St., New York manufacturer of paints, varnishes, etc., has leased a building now in course of erection at the northwest corner of Harris Ave. and the Boulevard for the establishment of a new plant. The Martini Artists' Color Laboratories, same address, manufacturer of artists' paints and colors, has leased property at the same location, Long Island City, for a new works.

SYRACUSE—Fire, Jan. 3, destroyed a portion of the tanning plant of the Onondaga Hide & Leather Co., East Water St., with loss estimated at about $45,000, including equipment. It is planned to rebuild.

Ohio

CINCINNATI — The Kemper-Thomas Co., Park Ave., near Floral Ave., Norwood, manufacturer of paper products, will take bids at once for the erection of a new 3-story and basement addition, 60x220 ft., to cost about $150,000, including equipment. Samuel Hannaford & Sons, 1024 Dixie Terminal Bldg., Cincinnati, are architects.

ZANESVILLE—Fire, Dec. 21, destroyed the enamel department and other portions of the plant of the Mark Mfg. Co., manufacturer of steel conduit, pipe, tubing, etc., with loss estimated at close to $400,000, including equipment. It is planned to rebuild. The company is a branch of the Steel & Tube Co. of America, Inc., 111 West Washington St., Chicago, Ill.

CAMBRIDGE—E. M. Darner, Zanesville, has acquired the local plant of the Guernsey Earthenware Co., at a receiver's sale, for a stated consideration of $80,500. The new owner is said to be planning to operate the pottery.

MIDDLETOWN—Z. W. Ranck and W. H. Muchmore, Shelby, O., have organized a new company to take over the property of the Shelby Wax Paper Co., Shelby. The equipment at the plant will be removed to the works of the Central Tissue Co., Middletown, wax paper department, which will be developed for large increase in capacity. Mr. Ranck will be president of the new company, and Mr. Muchmore, vice-president and general manager.

Oklahoma

RINGLING—The Gilmer Oil Co., Ardmore, Okla., has acquired a local refinery and has plans under way for extensions and improvements in the plant.

TULSA—J. J. Kerins, Tulsa, is perfecting plans for the organization of a company to construct and operate a new oil refining plant in the Tonkawa district. The initial plant will have a capacity of about 2,000 bbl. per day.

TULSA—The Producers' & Refiners' Corp., California Bldg. Denver, Colo., operating

local oil refineries, is completing arrangements for the purchase of the refining plants and properties of the Barnsdall Corp., the Texas-Pacific Coal & Oil Co., and the Fensland Oil Co., representing total assets of about $125,000,000, with plants in the Mid-Continent, Texas and Wyoming fields. The new owner plans for extensions and improvements for extensive increase in production.

MUSKOGEE—The Sinclair Refining Co. has perfected plans for the removal of its oil refinery at Vinita, Okla., to the refining plant at Muskogee, where the consolidation will be developed for considerable increase in production.

Oregon

ASTORIA—The Astoria Shope Brick Co. has acquired a local site for the erection of a new plant with initial output of about 35,000 bricks per day, and will break ground at an early date. A list of machinery to be installed is being arranged. The company has recently been organized with a capital of $250,000.

PORTLAND — The Portland Oxygen & Hydrogen Co., Center and East 17th Sts., has awarded a contract to the Hurley-Mason Co., Gasco Bldg., for the erection of a 1-story addition to its plant.

Pennsylvania

ZELIENOPLE — The Common Council is having plans prepared for the installation of a filtration plant at the municipal waterworks to cost about $35,000. Leo Hudson, Wabash Bldg., Pittsburgh, is engineer.

HAYSVILLE—Fire, Jan. 3, destroyed a portion of the plant of the Sterling Varnish Co., including two buildings, with loss estimated in excess of $50,000, including equipment. Headquarters of the company are in Fulton Bldg., Pittsburgh. James Todd is president.

POTTSVILLE — The Common Council has ordered a sanitary survey of the city, preparatory to the installation of a new sewage filtration plant, estimated to cost in excess of $500,000, with equipment, for which plans will be authorized in the near future.

PHILADELPHIA—S. Kardan, 2d and Vine Sts., manufacturer of paper products, has plans under way for the erection of a new 5- to 8-story plant at South, Swanson and Bainbridge Sts., estimated to cost about $500,000. Clarence E. Wunder, 1415 Locust St., is architect.

FARMERS VALLEY—A new company has been formed by Warren, Pa., interests for the construction and operation of a local oil refining plant, on site owned by the B. B. Stroud Gasoline Co., Coleville, near Farmers Valley, which is interested in the project.

South Carolina

PREGNALL—The Atlantic Turpentine Co., St. George, S. C., recently organized, has acquired local property and plans for the early erection of a new plant for extensive production. H. H. Gross is president; M. S. Connor, secretary and treasurer; and T. A. Patrick, general manager, the last two officials being located at St. George.

Texas

ELECTRA—The Griswold Oil Co., Henrietta, Tex., has completed arrangements with the Electra Chamber of Commerce and Agriculture, for the acquisition of a local site for the erection of a new oil refinery, estimated to cost close to $500,000. The present refining plant at Henrietta will be removed to the new location, with the installation of additional equipment for extensive increase in output, including 2 new cracking plants, and new casinghead gasoline works. The company has also secured the local property of J. F. Emerich in the South Electra field.

HOSKINS MOUND—The Freeport Sulphur Co., Freeport, Tex., has active construction in progress on its new local sulphur plant, estimated to cost in excess of $1,500,000. The works will include a large power house and a chemical-treatment water plant to handle approximately 3,500,000 gal. per day. It is expected to have the plant ready for operation early in the spring. C. M. Chapman is consulting engineer for the company.

SAN ANGELO — The San Angelo Water, Light & Power Co. is planning for the installation of a filtration plant at its local waterworks. The company is operated by the Interstate Electric Corp., 141 Broadway, New York. M. F. Treadwell is local manager at San Angelo.

Washington

VANCOUVER—The Columbia River Paper Mills, Inc., operated by the California-Oregon Paper Mills Co., East 57th St., Los Angeles, Cal., is perfecting plans for the erection of a new local plant. The city council is vacating a number of streets for the mills.

West Virginia

WHEELING—The Wheeling Steel Corp. has commenced the construction of a new sintering plant at its East Steubenville works, and plans to rush the structure to completion. Special furnaces will be installed to utilize the flue dust from the blast furnaces, converting it into a solid for iron manufacture.

Wisconsin

KENOSHA—The Frost Mfg. Co., Fremont St., manufacturer of brass castings, is considering plans for the construction of a new 1-story foundry. W. J. Frost is president.

Canada

WINNIPEG, MAN. — The Swift-Canadian Co., operated by Swift & Co., Union Stock Yards, Chicago, Ill., plans for the rebuilding of its Elmwood fertilizer plant, partly destroyed by fire, Dec. 22, with loss estimated at $35,000.

British Columbia

VICTORIA—D. D. McPhail, Kelso, Wash., and associates, are organizing a new company to construct and operate a large pulp and paper mill in the vicinity of Nitinat Lake. The initial plant unit is estimated to cost in excess of $500,000, and will be supplemented with other units at a later date, making an ultimate cost of more than $1,500,000.

Industrial Developments

LEATHER—The Carr Leather Co., Peabody, Mass., is running at full capacity with regular working force, and is said to have orders on hand to insure continuance on this basis for a number of months to come.

Glazed kid manufacturing plants at Camden, N. J., Philadelphia, Pa., and Wilmington, Del., are maintaining full operations with full working forces and propose to continue on this basis for an indefinite period.

The A. C. Lawrence Leather Co., Peabody, Mass., has resumed production at its local pig skin tannery, which has been practically idle for close to 2 years past. Initial operations will be on a curtailed capacity basis for the time being.

The Essex Tanning Co., Peabody, Mass., is running under heavy output at its plant, and has orders on hand to insure this basis for some time to come. A full working force is being employed.

GLASS—The Owens Bottle Co., Clarksburg, W. Va., has placed an additional unit in operation at its plant bringing production to a capacity basis, or 3,000 gross boxes of bottles per day. The plant will continue on this schedule for an indefinite period, giving employed to approximately 200 workers.

Glass factories in the vicinity of Paulsboro, N. J., are advancing operations and expect to give employment to an increased number of workers at the season matures. It is said that 1923 will be the busiest year since 1919.

Following a brief curtailment for inventory, the Indiana Glass Co., Dunkirk, Ind., has resumed production on a capacity basis and is said to have orders on hand to insure this schedule for a number of months to come.

Window glass manufacturers represented in the National Association of Window Glass Manufacturers have granted a wage increase of 13 per cent at all hand plants throughout the country, effective Jan. 29 and concluding June 11.

CERAMIC—The American Clay Products Co., New Hope, Pa., is perfecting arrangements for the opening of its local plant late in February. The works have been in course of erection since the spring of 1920, and are said to represent an investment of more than $1,000,000. The plant will specialize in the manufacture of shale brick and will develop an ultimate output of about 500,000 bricks per day.

The Carpenteria Clay Products Co., Carpenteria, Cal., has commenced operations at its new local plant, recently completed, and will concentrate on the manufacture of brick and hollow tile.

The Champion Spark Plug Co., Toledo, O., is advancing capacity at its plant and is now running on the basis of 120,000 spark plugs each working day.

The Bethlehem Spark Plug Co., Bethlehem, Pa., is running on a capacity basis and expects to continue this schedule for an indefinite period. An order has been secured from the International Harvester Co. for 1923 spark plugs, said to total $500,000; a large order has also been received from the Packard Motor Car Co.

The National Drain Tile Co., Summitville, near Anderson, Ind., has closed its local plant for an indefinite period.

The Thress Brick Co., Tuscaloosa, Ala., is planning for increased production at its plant.

RUBBER—The Goodyear Tire & Rubber Co., Akron, O., has resumed full production at its local plant following a short curtailment for inventory.

The Hood Rubber Co., Watertown, Mass., is maintaining full capacity at its mill and will continue on this basis for an indefinite period. A new record output has been established.

IRON AND STEEL—The American Sheet & Tin Plate Co. has resumed operations at its La Belle Works, Wheeling, W. Va., with a full working force, after a shut down for the past 6 months.

The Conners Steel Co., Birmingham, Ala., has resumed operations on a capacity basis at its hoop and band mills.

The Standard Tin Plate Co., Canonsburg, Pa., has resumed operations at 8 hot mills, suspended on account of necessary repair work a few months ago, making a complete battery of 24 mills in service on full turn. The plant is giving employment to about 2,500 men.

The Delaware River Steel Co. has arranged for the blowing in of its blast furnace at Chester, Pa., on foundry iron. A normal working force will be employed.

The Hall blast furnace, Sharon, Pa., will be dismantled. The unit has been inactive for a number of years past. A portion of the equipment will be utilized at a plant at Youngstown, O.

A total of 24 blast furnaces are now in operation in Alabama, the largest number in service at one time for the past 2 years. Production is being concentrated on pig iron, with full time working forces. Ten of the furnaces are owned by the Tennessee Coal, Iron & Railroad Co.; 5 by the Sloss-Sheffield Coal & Iron Co.; 4 by the Woodward Iron Co.; 2 by the Republic Iron & Steel Co.; and one furnace each by the Gulf States Steel Corp., the Alabama Co., and the Central Iron & Coal Co.

The McCullough Iron Works, Wilmington, Del., has been sold and the plant will be dismantled.

The United States Steel Corp., is maintaining 100 per cent capacity operations at its mills in the Youngstown O., district.

MISCELLANEOUS — The National Sulphur Co., North Akron, O., has arranged for immediate operations at its new local plant, recently completed.

The Pyrites Co., Ltd., Roanoke, Va., has repairs in progress at its local plant and plans to resume production at an early date. The plant has been closed for about 18 months past.

The United States Graphite Co., Saginaw, Mich., is arranging for the immediate resumption of operations at its La Colorado properties at Torres, Mex.

The Morse Blacking Co., Peabody, Mass., manufacturer of shoe polishes and kindred products, is running on a capacity basis, with sufficient orders on hand to maintain this schedule for some time to come.

Four out of 8 oil refineries in the Ardmore, Okla., district are on the producing list, these being the Cameron Refining Co., operating at 2,600 bbl. per day, with capacity rating of 3,000 bbl.; the Pure Oil Refining Co., on a 2,700 bbl., daily output, and capacity rating of 7,000 bbl.; the Imperial Refining Co., on a basis of 4,000 bbl., with maximum plant capacity of 5,000 bbl.; and the Nyanza Refining Co., 1,500 bbl., daily production, with rated capacity of 3,500 bbl.

Employees at the refining plant of the Standard Oil Co., Bayonne, N. J., have submitted a petition to the company asking a general wage increase.

The Fort William Pulp & Paper Co., Ottawa, Can., is arranging to increase production at its mills to an average of 150 tons of newsprint per day.

The Anaconda Copper Co., 25 Broadway, New York, is planning to inaugurate operations at the first unit of its new zinc oxide plant at East Akron, O., now nearing completion, early in February.

The American Cotton Oil Co. has closed 6 mills in Georgia and 2 mills in South Carolina for an indefinite period. It is said that some of the plants will be abandoned. Divisional headquarters have been moved from Atlanta, Ga., to Memphis, Tenn.

Capital Increases, etc.

THE CENTRAL MICHIGAN PAPER CO., Grand Rapids, Mich., has filed notice of increase in capital from $25,000 to $300,000 for proposed general expansion.

THE NASSAU SMELTING & REFINING WORKS, INC., 603 West 29th St., New York, N. Y., has arranged for an increase in capital from $1,000,000 to $1,500,000.

THE LOUISVILLE PAPER CO., Louisville, Ky., has filed notice of increase in capital to $750,000 for proposed expansion.

THE GILL CLAY POT CO., Muncie, Ind., has filed notice of increase in capital from $100,000 to $200,000 for expansion.

THE TEXAS PORTLAND CEMENT CO., Dallas, Tex., has arranged for an increase in capital from $1,000,000 to $2,000,000 for proposed expansion.

THE THOMAS MADDOCK'S SONS CO., Trenton, N. J., manufacturer of sanitary ware, has filed notice of increase in capital from $600,000 to $1,435,000.

THE SWIGART PAPER CO., 653 South Wells St., Chicago, Ill., has arranged for an increase in capital from $750,000 to $950,000.

THE CHARLES H. PHILLIPS CHEMICAL CO., Stamford, Conn., has arranged for an increase in capital from $50,000 to $450,000 for expansion.

New Publications

BOOKS

IRON ORE (Summary of Information as to the Present and Prospective Iron-Ore Supplies of the World), Part 7, Foreign America. H. M. Stationery Office, London. 136 pp., 3 maps. Price, 4s. 4½d.

A comprehensive economic survey is made of the iron ore resources of the United States, Cuba and the West Indies, Mexico and Central and South America. Particular attention is given to the geological aspects of this question, to the economic position of the various competing districts and to the statistics of production and trade.

A FIRST BOOK OF CHEMISTRY. By *A. Coulthard.* Technical Research Chemist with the British Dyestuffs Corporation, Ltd. Published by Pitman & Sons, London. 136 pages, 3 maps. Price, 4s. 4½d.

This is a rather unusual little book designed as a text for students in a junior technical school where a year's work devoting 3 to 4 hours a week to chemistry is undertaken. The author, probably because of his long teaching experience, has admirably succeeded in projecting himself to the beginner's viewpoint, with the result that he has produced a textbook of unusual value.

TESTING METHODS OF METALLURGICAL ANALYSIS (NON-FERROUS). By *Seymour Pile* and *Reginald Johnston*, with a prefatory note by *C. T. Haycock*. Published by H. F. & G. Witherby, London. Price, 7s. 6d. net.

The authors have attempted to sort out from the extensive literature on non-ferrous chemical analysis those methods which appeared most practical for ordinary usage. These were thoroughly tested and attention was given to the various manipulative details so often necessary for the success of the particular method. The book is "intended to be to the analyst what a set of working drawings are to the mechanic."

COMMERCIAL TRAVELER'S GUIDE TO LATIN AMERICA. U. S. Department of Commerce, Miscellaneous Series No. 89. Superintendent of Documents, Government Printing Office, Washington, D. C. Price, $1.25.

Everything that the commercial traveler should know about the twenty republics and many colonies to the south of us, in order to make a profitable and enjoyable business trip, is encompassed in 734 pages. It is compiled by Ernest B. Filsinger, assisted by corps of experts of the Department of Commerce. Steamship lines and railroads, time tables and connections, road routes, hotels and rates, taxes on travelers and restrictions, duties on samples and advertising matter; nothing essential is omitted. The traveler is told about the banks, postal service and postal rates, weights and measures, and all things that may obviate those vexatious delays which are especially troublesome to the uninformed and inexperienced traveler in Latin America. Every city and market of importance in the Latin Americas is listed with informtaion as to its characteristics, trade regulations, license fees, routes by which to reach it, etc., and the traveler is given abundant sound advice to be followed in canvassing each section.

Industrial Notes

THE PITTSBURGH-DES MOINES STEEL CO., Pittsburgh, Pa., announces that from Jan. 1, 1923, Joseph S. Harrison is made advertising manager of the company. I. A. Bickelhaupt, the former advertising manager, moves temporarily to Richmond, Va., and opens a sales and construction office for the company. The Richmond office will handle the entire southeast territory from Baltimore on the north and Birmingham on the west.

THE INDUSTRIAL BUREAU OF THE CHAMBER OF COMMERCE, 32 Court St., Brooklyn, N. Y., has issued a map showing graphically the vast industries of Brooklyn. Eleven of the main industries are shown by bars made on a percentage basis.

THE PRECISION INSTRUMENT CO., of Newark, N. J., and Detroit, Mich., announces that Alfred B. Carhart has resigned his position as vice-president and sales manager of the Crosby Steam Gage & Valve Co. to become president and general manager of the Precision Instrument Co., Inc., which has acquired control of the Precision Instrument Co. The present executive officers will retain their connection with the company. It is expected to enlarge the business considerably, with new capital, adding specialties, also staple lines of gages, valves and fittings. Mr. Carhart assumes his duties at once and will be located at the New York office at 114 Liberty St. The factory will later be moved to New York.

THE INGERSOLL-RAND CO. and the A. S. CAMERON STEAM PUMP WORKS announce the opening of a branch office at 718 Ellicott Square Bldg., Buffalo, N. Y.

HOWARD E. EDDY, formerly identified with Manning, Maxwell & Moore, Inc., of New York, has become vice-president and general manager of the Nelson Valve Co., Philadelphia, Pa. C. W. Brown, of Philadelphia is secretary and treasurer. C. D. Miller, formerly identified with the Bridgeport Works of Manning, Maxwell & Moore, Inc., is works manager, and C. W. Burrage of the same company mechanical engineer.

THE FRASSE STEEL WORKS, INC., Hartford, Conn., has been appointed the exclusive New England distributor for the Sizer Steel Corp., with plants at Buffalo and Solvay (Syracuse). The company manufactures electric carbon, alloy and tool steels, bars, billets and forging and die blocks.

THE PETROLEM IRON WORKS CO., Sharon, Pa., announces that its Denver office in the First National Bank Bldg., has been discontinued. T. J. Mullin, formerly the Denver representative, is now located in the St. Louis office in the Central National Bank Bldg. A new office to serve the Western territory has been opened in Casper, Wyo., at 407 Oil Exchange Bldg., in charge of H. S. Dilcher.

THE CARPENTER STEEL CO., of Reading, Pa., announces that statements in newspapers and elsewhere reporting the merger of the company with some other steel concern, or its sale to other interests, are entirely erroneous.

H. H. REPLOGLE has resigned as manager of the intermediates and certified food color divisions of the National Aniline & Chemical Co. to assume the sales management of the Wamesit Chemical Co., Lowell, Mass., domestic manufacturer of lactic acid, lactates, lactart and lactic acid compounds.

THE NATIONAL TUBE CO., of Pittsburgh, Pa., has announced the establishment of an industrial fellowship in the Mellon Institute of Industrial Research of the University of Pittsburgh, Pa. This fellowship is engaged in a systematic study of practical methods for the prevention of corrosion in hot-water supply systems. It is also giving attention to the classification of waters of various chemical composition, with respect to their relative corrosive action upon iron and steel, particularly in the form of pipe lines, boiler-economizers, tubes, etc. The present incumbent of the fellowship is Clifford R. Texter, who for the past several years has been carrying out research on the corrosion of iron and steel where not exposed directly to the atmosphere. Mr. Texter will be glad to correspond with engineers and manufacturers interested in the field to which his fellowship relates.

THE WILSON WELDER & METALS CO., New York, is now represented exclusively in Maryland, Virginia and the District of Columbia by the Alexander Milburn Co., of Baltimore. A large stock of color-tipt welding metals and plastic-arc welding machines is available at this point for distribution throughout the territory and a complete demonstration plant in operation.

George Macnoe, manager of the Boston office of W. B. CONNOR, INC., has been recalled to New York to take charge of the contractors' sales department, handling heating and pumping equipment.

THE RUBBER ASSOCIATION OF AMERICA, INC., announces the removal of its office to 250 West 57th St., New York City.

William T. Hand has severed his connection with the TECHNICAL PRODUCTS CO., INC., and has organized the William T. Hand Equipment Co. at 2709 Grand Central Terminal, N. Y., which will specialize in new and used chemical process equipment.

THE LINDE AIR PRODUCTS CO. has obtained a site in St. Louis and North Anthony Sts., New Orleans, for a large branch factory for the production of hydrogen and oxygen and their products. The first unit of the plant is but a small part of the ultimate plant representing an investment of $130,000.

The Ashburn plant of E. I. DU PONT DE NEMOURS & Co. has lately been put in operation after having been closed for a year. M. C. Knabe has been appointed manager and P. C. Kaiser is assistant manager. The technical staff is composed of the following men: F. E. Jacquot, superintendent of powder lines; P. S. Cushing is superintendent of acid manufacture and G. A. Beane is superintendent of power.

THE PRECISION INSTRUMENT CO., Newark, N. J., and Detroit, Mich., is offering to the trade a new CO_2 recorder. This recorder will embody all the good features of the present Precision CO_2 recorder, but is an innovation in that it will remove CO_2 recorders from the present laboratory types to the boiler room equipment. The salient features are: Motor drive of the G.E. type, constant speed; direct drive, no belts; positive in action; elimination of water or steam troubles; no glass parts; simplicity of design and operation; accurate in results and powerful enough to overcome any boiler suction.

Coming Meetings and Events

AMERICAN CERAMIC SOCIETY will hold its annual meeting in Pittsburgh, Pa., Feb. 12 to 17, 1923.

AMERICAN CHEMICAL SOCIETY will hold its spring meeting April 3 to 7, 1923, at New Haven, Conn.

AMERICAN ELECTROCHEMICAL SOCIETY will hold its spring meeting May 3, 4 and 5, 1923, at the Commodore Hotel, New York 1923, at the Commodore Hotel, New York.

AMERICAN INSTITUTE OF MINING AND METALLURGICAL ENGINEERS will hold its annual meeting in New York City during the week of Feb. 19, 1923.

AMERICAN SOCIETY FOR STEEL TREATING will hold its winter sectional meeting in the City Club, Chicago, Feb. 8 and 9, 1923.

AMERICAN SOCIETY FOR TESTING MATERIALS will hold its twenty-sixth annual meeting at the Chalfonte-Haddon Hall Hotel, Atlantic City, beginning Monday, June 25, 1923, and ending either Friday or Saturday of that week.

INTERNATIONAL CHAMBER OF COMMERCE will hold its second general meeting in Rome, Italy, March 19-26, 1923.

NATIONAL FOREIGN TRADE COUNCIL will hold its annual conference April 25, 26 and 27, 1923, in New Orleans, La.

NEW JERSEY CHEMICAL SOCIETY holds a meeting at Stetters Restaurant, 842 Broad St., Newark, N. J., the second Monday of every month.

SOCIETY OF INDUSTRIAL ENGINEERS, with headquarters in Chicago, will hold its spring convention in Cincinnati, April 18, 19 and 20, 1923. The major subject will be "Management Problems of the Smaller Plants."

A PAPER INDUSTRIES EXPOSITION will be held in Grand Central Palace, New York City, during the week of April 9, 1923, by the International Exposition Co.

The following meetings are scheduled to be held in Rumford Hall, Chemists' Club, East 41st St., New York City: Feb. 9—American Electrochemical Society (in charge). Society of Chemical Industry, Société de Chimie Industrielle, American Chemical Society joint meeting. March 9 American Chemical Society, Nichols Medal. March 23—Society of Chemical Industry, regular meeting. April 20—Society of Chemical Industry (in charge), American Electrochemical Society, Société de Chimie Industrielle, American Chemical Society, joint meeting. May 4—American Chemical Society, regular meeting. May 11—Société de Chimie Industrielle (in charge), American Chemical Society, American Electrochemical Society, Society of Chemical Industry, joint meeting. May 18—Society of Chemical Industry, regular meeting. June 8—American Chemical Society, regular meeting.